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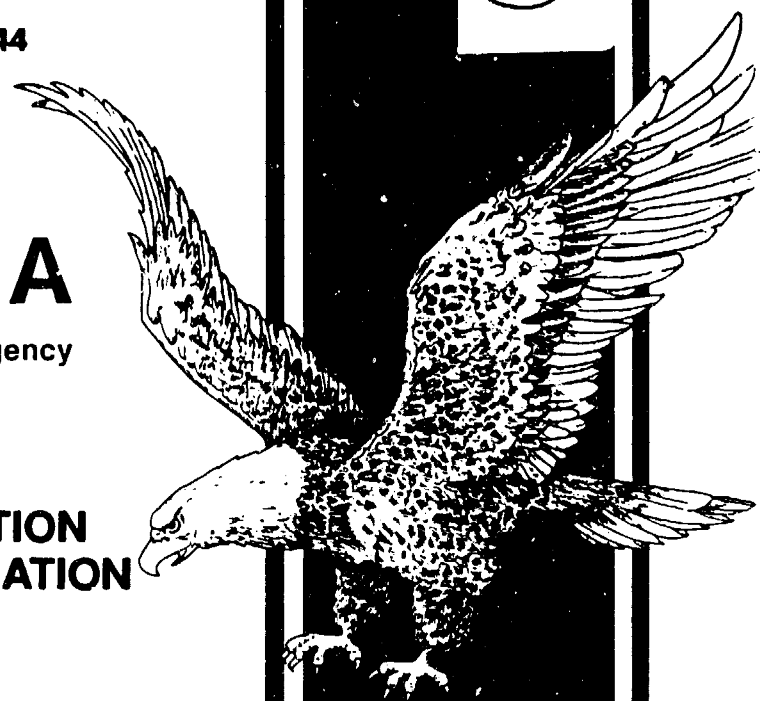
Final Report Appendices



USATHAMA

U.S. Army Toxic and Hazardous Materials Agency

AD-A206 254

BALL POWDER PRODUCTION WASTEWATER BIODEGRADATION SUPPORT STUDIES

(TASK ORDER NO. 11)

February 1989
Contract No. DAAK11-85-D-0008

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Final Report to
United States Army Toxic and Hazardous Materials Agency
February 1989

Ball Powder Production Wastewater Pilot-Scale Biodegradation Support Studies

(Task Order Number 11/Subtask 11.1)

Final Report Appendices

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)
Introduction: At the present time, ball powder is produced at only two locations in the United States: Badger AAP in Baraboo, Wisconsin and Olin Corporation's commercial facility in St. Marks, Florida. Badger AAP was constructed during World War II, operated intermittently from 1943 to 1975, and then placed in its present caretaker status. Due to the less stringent regulatory climate of that time and the fact that the plant ceased operations in 1975, no facility presently exists for treating wastewater generated if the plant were ever to resume operation. Consequently, USATHAMA sponsored a program to evaluate and test treatment technologies to allow Badger AAP to meet anticipated NPDES limits.

The program was begun with a literature review of physical/chemical and biological treatment technologies which led to the selection of biological oxidation as the candidate technology for further study. However, due to the fact that a paucity of information existed on biological treatment of ball powder wastewater, it was decided that the first phase of this task

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#18 (continued): • Aerobic Biological Oxidation • Diphenylamine Pollutants • Dibutyl-phthalate Pollutants • n-Nitrosodiphenylamine Pollutants

#19 (continued): would be a laboratory study whereby the two general classes of biological treatment systems (fixed film and suspended growth) could be evaluated. The laboratory tests were performed during February and March of 1987, and the results showed that while both the rotating biological contactors (fixed film) and activated sludge (suspended growth) units met the anticipated NPDES requirements of 45 mg/L for BOD and detection limits (2.5 ug/L) for DBP the RBCs seemed incapable of meeting the requirement of detection limits (1.9 ug/L) for DPA. The activated sludge units did not remove DPA to detection limits either, but the trend in these units was towards complete DPA removal as the biomass became acclimated, whereas the RBCs' removal efficiency of the NDPA did not appear to change with acclimation.

Based on the results of the laboratory study, we recommended that two types of activated sludge systems with low food-to-mass (F:M) ratios, extended aeration and SBR, be tested on a pilot-scale at Badger AAP. Extended aeration was selected because it is the most prevalent form of activated sludge operated at a low F:M ratio. The SBR was chosen even though it is not as prevalent as extended aeration, because it offers greater operating flexibility so as to accommodate varying wastewater feed rates and better control the anoxic period for the removal of nitrates. The objectives of the pilot program were twofold: 1) to determine the ability of the candidate biological oxidation system to produce a treated wastewater stream capacle of meeting NPDES requirements; and 2) to develop preliminary design criteria for use in the ultimate engineering, design, and costing of a full-scale system.

To meet the objectives, a test plan was developed and testing was performed over a period of eight months. During that period, each of the two systems was operated for approximately four months using actual wastewater that was generated in Badger AAP's pilot ball powder facilities. The wastewater was produced in a manner consistent with production in the full-scale ball powder lines with the exception that nitroglycerin (NG) was not added in the coati[illegible] phase. The reason for omitting NG was to allow the wastewater samples to be shipped by air to the USATHAMA certified laboratory in Salt Lake City, Utah. The omission of NC from the waste-water was not felt to change the toxicity or biodegradability of the wastewater because it wa[illegible] predicted to be in low concentration (approximately 8 mg/L).

<u>Results and Conclusions</u>: Pilot test results have indicated that both of the systems investigated are capable of meeting anticipated NPDES requirements (BOD, TSS, and NO_3-N), including detection limits for NDPA and DBP. The major difference between the two systems was the optimum F:M ratios, 0.11 day^{-1} for extended aeration and 0.14^{-1} for SBR. This difference in F:M ratios resulted in the SBR being slightly more efficient at removing organics.

In addition to meeting NPDES requirements, neither the extended aeration nor the SBR system was difficult to operate or had any maintenance problems that would appear to be of concern in a full-scale system. However, the SBR system was easier to operate and maintain, due to the fact that it is computer controlled and operates without a separate clarifier.

Based on the results of the pilot test program, a preliminary design was developed for both systems. The most notable differences between these two systems are:

- Extended aeration requires a 30% larger reactor volume than the SBR;
- Extended aeration requires two 3,750 ft^2 clarifiers while the SBR requires none; and
- Extended aeration requires nearly 25% less oxygen than the SBR.

The conclusion from the pilot program is that both systems are capable of meeting NDPES requirements; therefore, as a final recommendation, an economic analysis of both the extended aeration and SBR biological treatment systems should be performed to determine if either system is more cost effective.

(continued on next page)

Near the conclusion of the pilot-scale tests, a concern was raised as to the actual concentration of NG in the wastewater and the ability of a biological treatment system to handle NG. Therefore, an additional phase of testing with NG was proposed and, subsequently, conducted. The results from the NG test program are not included in this report but are included in a companion document under the same report number and entitled, "Ball Powder Production Wastewater Pilot-Scale Biodegradation Support Studies - with Nitroglycerin."

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF FIGURES (Continued)

Appendix A
Extended Aeration Raw Data

TABLE OF CONTENTS

Arthur D Little

TABLE A.1

BOD Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet BOD (mg/L)	Reactor Sample Number	Reactor BOD (mg/L)	Effluent Sample Number	Effluent BOD (mg/L)
10/12/87	0	157B	318			160B	29
10/13/87	1	179B	400	177B	1690	175B	22
10/14/87	2	187B	330	185B	1210	181B	13
10/15/87	3	191B	270	193B	1110	195B	11
10/16/87	4	205B	660	207B	1010	209B	13
10/19/87	7	213B	600	215B	1330	217B	20
10/20/87	8	225B	650	227B	1640	229B	35
10/21/87	9	236B	490	242B	1120	239B	31
10/22/87	10	246B	670	248B	1140	250B	33
10/23/87	11	261B	720	263B	1190	265B	38
10/26/87	14	271B	720	274B	19	276B	38
10/27/87	15	279B	630	281B	14	283B	36
10/28/87	16	287B	570	290B	19	292B	31
10/29/87	17	301B	460	303B	16	305B	27
10/30/87	18	312B	640	314B	7	316B	56
11/02/87	21	322B	630	324B	10	326B	30
11/03/87	22	330B	690	332B	22	334B	58
11/04/87	23	338B	490	341B	12	343B	38
11/06/87	25	359B	890	361B	21	363B	69
11/09/87	28	370B	1090	372B	17	374B	48
11/10/87	29	379B	970	381B	10	383B	39
11/11/87	30	392B	1290	395B	8	397B	56
11/12/87	31	415B	970	417B	28	419B	41
11/13/87	32	426B	900	428B	60	430B	48
11/16/87	35	446B	780	448B	14	450B	86

Source: Strand Associates, Inc.

TABLE A.1 (CONTINUED)

BOD Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet BOD (mg/L)	Reactor Sample Number	Reactor BOD (mg/L)	Effluent Sample Number	Effluent BOD (mg/L)
11/17/87	36	454B	850	456B	6	458B	89
11/18/87	37	466B	800	468B	5	470B	45
11/19/87	38	484B	790	486B	5	488B	116
11/20/87	39	495B	840	497B	11	499B	53
11/23/87	42	505B	890	507B	7	509B	63
11/24/87	43	514B	870	517B	10	519B	67
11/25/87	44	529B	840	531B	2	533B	53
11/26/87	45	538B	860	540B	8	542B	27
11/27/87	46	548B	1300	550B	4	552B	36
11/30/87	49	563B	1080	565B	10	567B	20
12/01/87	50	578B	520	580B	4	582B	26
12/02/87	51	590B	240	593B	40	595B	7
12/03/87	52	605B	810	607B	9	609B	28
12/04/87	53	619B	870	621B	11	623B	8
12/07/87	56	629B	800	631B	2	633B	8
12/08/87	57	640B	770	642B	2	644B	12
12/09/87	58	653B	720	656B	2	658B	7
12/10/87	59	665B	730	667B	2	669B	4
12/11/87	60	717B	810	719B	3	721B	11
12/14/87	63	733B	760	735B		737B	10
12/15/87	64	756B	780	758B	2	760B	10
12/16/87	65	771B	860	773B	2	775B	8

Source: Strand Associates, Inc.

Arthur D Little

TABLE A.2

COD Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet COD (mg/L)	Reactor Sample Number	Reactor COD (mg/L)	Effluent Sample Number	Effluent COD (mg/L)
10/12/87	0	158B	471			161B	132
10/13/87	1	180B	447	178B	3270	176B	69
10/14/87	2	189B	410	186B	2675	183B	43
10/15/87	3	192B	352	194B	2795	196B	25
10/16/87	4	206B	1026	208B	2805	210B	38
10/19/87	7	214B	886	216B	3715	218B	61
10/20/87	8	226B	886	228B	3335	230B	74
10/21/87	9	237B	863	243B	160	240B	80
10/22/87	10	247B	918	249B	168	251B	82
10/23/87	11	262B	1072	264B	189	266B	90
10/26/87	14	272B	972	275B	146	277B	132
10/27/87	15	280B	940	282B	167	284B	91
10/28/87	16	288B	831	291B	132	293B	72
10/29/87	17	302B	841	304B	144	306B	117
10/30/87	18	313B	1143	315B	162	317B	197
11/02/87	21	323B	1014	325B	191	327B	177
11/03/87	22	331B	1056	333B	96	335B	236
11/04/87	23	339B	882	342B	213	344B	205
11/05/87	24	349B	951	351B	108	353B	215
11/06/87	25	360B	848	362B	169	364B	246
11/09/87	28	371B	1462	373B	174	375B	191
11/10/87	29	380B	1380	382B	216	384B	176
11/11/87	30	393B	1390	396B	195	398B	130
11/12/87	31	416B	1570	418B	162	420B	123
11/13/87	32	427B	1420	429B	206	431B	317

Source: Strand Associates, Inc.

TABLE A.2 (CONTINUED)

COD Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet COD (mg/L)	Reactor Sample Number	Reactor COD (mg/L)	Effluent Sample Number	Effluent COD (mg/L)
11/16/87	35	447B	1250	449B	234	451B	290
11/17/87	36	455B	1220	457B	188	459B	260
11/18/87	37	467B	1030	469B	198	471B	175
11/19/87	38	485B	1100	487B	225	489B	345
11/20/87	39	496B	1315	498B	202	500B	193
11/23/87	42	506B	1276	508B	160	510B	255
11/24/87	43	515B	1285	518B	125	520B	219
11/25/87	44	530B	1380	532B	126	534B	192
11/26/87	45	539B	1925	541B	190	543B	138
11/27/87	46	549B	1852	551B	173	553B	122
11/30/87	49	564B	1340	566B	142	568B	98
12/01/87	50	579B	1220	581B	111	583B	133
12/02/87	51	591B	527	594B	96	596B	90
12/03/87	52	606B	1370	608B	207	610B	82
12/04/87	53	620B	1430	622B	103	624B	58
12/07/87	56	630B	1162	632B	76	634B	55
12/08/87	57	641B	1170	643B	106	645B	56
12/09/87	58	654B	1100	657B	98	659B	49
12/10/87	59	666B	1140	668B	108	670B	38
12/11/87	60	718B	1196	720B	100	722B	45
12/14/87	63	734B	997	736B	105	738B	30
12/15/87	64	757B	1094	759B	88	761B	43
12/16/87	65	772B	1220	774B	84	776B	33

Source: Strand Associates, Inc.

TABLE A.3

MLSS Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet TSS (mg/L)	Reactor Sample Number	Reactor MLSS (mg/L)	Effluent Sample Number	Effluent TSS (mg/L)
10/12/87	0	157B	11		3315	160B	108
10/13/87	1			177B	3315		
10/14/87	2	187B	12	185B	3200	181B	28
10/15/87	3			193B	3280		
10/16/87	4	205B	8	207B	3211	209B	21
10/19/87	7	213B	10	215B	3671	217B	47
10/20/87	8			227B	3600		
10/21/87	9	236B	20	242B	3330	239B	8
10/22/87	10			248B	3140		
10/23/87	11	261B	25	263B	3482	265B	72
10/26/87	14	271B	8	274B	3582	276B	7
10/27/87	15			281B	3150		
10/28/87	16	287B	36	290B	3252	292B	66
10/29/87	17			303B	3400		
10/30/87	18	312B	26	314B	3340	316B	162
11/02/87	21	322B	6	324B	3107	326B	113
11/03/87	22			332B	3920		
11/04/87	23	338B	66	341B	3040	343B	158
11/05/87	24			350B	3800		
11/06/87	25	359B	98	361B	3510	363B	102
11/09/87	28	370B	14	372B	3750	374B	111
11/10/87	29			381B	4260		
11/11/87	30	392B	26	395B	4150	397B	75
11/12/87	31			417B	4400		
11/13/87	32	426B	12	428B	4030	430B	117

Source: Strand Associates, Inc.

TABLE A.3 (CONTINUED)

MLSS Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet TSS (mg/L)	Reactor Sample Number	Reactor MLSS (mg/L)	Effluent Sample Number	Effluent TSS (mg/L)
11/16/87	35	446B	29	448B	3750	450B	220
11/17/87	36			456B	3563	458B	220
11/18/87	37	466B	42	468B	3970	470B	124
11/19/87	38			486B	3510	488B	316
11/20/87	39	495B	40	497B	3780	499B	174
11/23/87	42	505B	24	507B	3057	509B	187
11/24/87	43			517B	2922	519B	170
11/25/87	44	529B	37	531B	2935	533B	161
11/26/87	45			540B	2888	542B	108
11/27/87	46	548B	32	550B	2614	552B	99
11/30/87	49	563B	30	565B	2900	567B	51
12/01/87	50			580B	2866	582B	73
12/02/87	51	590B	62	593B	2610	595B	52
12/03/87	52			607B	2790	609B	54
12/04/87	53	619B	34	621B	2780	623B	24
12/07/87	56	629B	29	631B	2750	633B	17
12/08/87	57	NS		642B	2730	644B	23
12/09/87	58	653B	44	656B	2830	658B	25
12/10/87	59	NS		667B	2940	669B	18
12/11/87	60	717B		719B	2850	721B	8
12/14/87	63	733B	20	735B	2700	737B	17
12/15/87	64	NS		758B	2630	760B	10
12/16/87	65	771B	30	773B	3210	775B	10

NS = No Sample

Source: Strand Associates, Inc.

TABLE A.4

MLVSS Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Reactor Sample Number	Reactor MLVSS (mg/L)
10/13/87	1	177B	2400
10/14/87	2	185B	2104
10/15/87	3	193B	2238
10/16/87	4	207B	2251
10/19/87	7	215B	2670
10/20/87	8	227B	2611
10/21/87	9	242B	2450
10/22/87	10	248B	2320
10/23/87	11	263B	2651
10/26/87	14	274B	2788
10/27/87	15	281B	2468
10/28/87	16	290B	2520
10/29/87	17	303B	2840
10/30/87	18	314B	2300
11/02/87	21	324B	2730
11/03/87	22	332B	2910
11/04/87	23	341B	2361
11/05/87	24	350B	3040
1[illegible]/87	25	361B	2890
1[illegible]/87	28	372B	2943
11/10/87	29	381B	3430
11/11/87	30	395B	3240
11/12/87	31	417B	3630
11/13/87	32	428B	3320

Source: Strand Associates, Inc.

TABLE A.4 (CONTINUED)

MLVSS Results for Extended Aeration Without Nitroglycerin

		Reactor	
Date (MM/DD/YY)	Day After Startup	Sample Number	MLVSS (mg/L)
11/16/87	35	448B	2910
11/17/87	36	456B	2800
11/18/87	37	468B	2820
11/19/87	38	486B	2480
11/20/87	39	497B	2840
11/23/87	42	507B	2164
11/24/87	43	517B	2300
11/25/87	44	531B	2395
11/26/87	45	540B	2294
11/27/87	46	550B	2064
11/30/87	49	565B	2376
12/01/87	50	580B	2250
12/02/87	51	593B	2060
12/03/87	52	607B	2133
12/04/87	53	621B	2320
12/07/87	56	631B	2035
12/08/87	57	642B	2345
12/09/87	58	656B	2365
12/10/87	59	667B	2320
12/11/87	60	719B	2226
12/14/87	63	735B	
12/15/87	64	758B	1980
12/16/87	65	773B	2630

Source: Strand Associates, Inc.

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TABLE A.5

TDS Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet TDS (mg/L)	Effluent Sample Number	Effluent TDS (mg/L)
10/12/87	0	157B	2198	160B	2100
10/14/87	2	187B	2148	181B	2278
10/16/87	4	205B	2208	209B	2066
10/19/87	7	213B	2276	217B	2104
10/21/87	9	236B	2195	239B	2115
10/23/87	11	261B	3925	265B	2180
10/26/87	14	271B	3585	276B	2665
10/28/87	16	287B	4110	292B	3780
10/30/87	18	312B	3980	316B	3830
11/02/87	21	322B	3898	326B	4018
11/04/87	23	338B	3792	343B	3734
11/06/87	25	359B	4002	363B	3900
11/09/87	28	370B	3866	374B	3830
11/11/87	30	392B	3952	397B	3803
11/13/87	32	426B	3950	430B	3674
11/16/87	35	446B	3640	450B	3690
11/18/87	37	466B	3730	470B	3870
11/20/87	39	495B	3716	499B	3890
11/23/87	42	505B	3704	509B	3748
11/25/87	44	529B	3955	533B	3618
11/27/87	46	548B	3712	552B	3582
11/30/87	49	563B	3910	567B	3745

Source: Strand Associates, Inc.

TABLE A.5 (CONTINUED)

TDS Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet TDS (mg/L)	Effluent Sample Number	Effluent TDS (mg/L)
12/02/87	51	590B	3930	595B	4028
12/04/87	53	619B	3778	623B	3726
12/07/87	56	629B	3860	633B	3990
12/09/87	58	653B	3630	658B	3678
12/11/87	60	717B	3510	721B	3855
12/14/87	63	733B	3642	737B	3836
12/16/87	65	771B	3800	775B	3860

Source: Strand Associates, Inc.

TABLE A.5 (CONTINUED)

Change In TDS During Five Day Holding Period

Week End Date MM/DD/YY	Initial TDS mg/L	Final TDS mg/L	Percent Reduction
11/02/87	4110	3898	5
11/09/87	4002	3866	3
11/16/87	3952	3640	8
11/23/87	3730	3704	1
11/30/87	3955	3910	1
12/07/87	3930	3860	2
12/14/87	3630	3642	0
AVERAGE	3901	3789	3

Source: Strand Associates, Inc.

TABLE A.6

NH3-N Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet NH3-N (mg/L)	Effluent Sample Number	Effluent NH3-N (mg/L)
10/12/87	0	158B	38.6	161B	5.5
10/23/87	11	262B	39.4	266B	3.4
10/30/87	18	313B	40.2	317B	19.2
11/06/87	25	360B	66.9	364B	2.6
11/13/87	32	427B	98.4	431B	1.49
11/20/87	39	496B	58.4	500B	1.18
11/27/87	46	549B	5.4	553B	0.8
12/04/87	53	620B	4.2	624B	0.67
12/11/87	60	718B	39.4	722B	1.78
12/14/87	63	734B	36.9	738B	1.07
12/15/87	64	757B	24.9	761B	1.44

Source: Strand Associates, Inc.

TABLE A.7

NO3-N Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet NO3-N (mg/L)	Effluent Sample Number	Effluent NO3-N (mg/L)
10/15/87	3	198B	0.17	201B	1.2
10/22/87	10	253B	1	256B	65
10/29/87	17	308B	1.5	310B	110
11/05/87	24	355B	1	358B	120
11/12/87	31	422B	1.1	425B	73
11/19/87	38	492B	0.71	493B	86
11/27/87	46	555B	0.97	558B	60
12/03/87	52	614B		615B	
12/10/87	59	674B	1.2	675B	56
12/16/87	65	786B	0.53	787B	46

Source: DataChem

TABLE A.8

TKN Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet TKN (mg/L)	Effluent Sample Number	Effluent TKN (mg/L)
10/12/87	0	158B	62.4	161B	8.9
10/16/87	4	206B	71.9	210B	7.2
10/19/87	7	214B	71.6	218B	5.8
10/23/87	11	259B	64.3	266B	3.4
10/26/87	14	272B	87.8	277B	9.7
10/30/87	18	313B	91.8	317B	26.7
11/06/87	25	360B	105	364B	7.3
11/13/87	32	427B	37.4	431B	14.5
11/20/87	39	496B	71.3	500B	10
11/23/87	42	506B	76	510B	11.5
11/27/87	46	549B	54.7	553B	8.3
11/30/87	49	564B	54.8	568B	6.5
12/04/87	53	620B	60.1	624B	6.6
12/11/87	60	718B	56.4	722B	8.4
12/14/87	63	734B	55.2	738B	3.8
12/15/87	64	757B	63.8	761B	5.2

Source: Strand Associates, Inc.

TABLE A.9

DBP Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DBP (ppb)	Effluent Sample Number	Effluent DBP (ppb)
10/13/87	1	172B	803	173B	0.4
10/14/87	2	190B	390	184B	0
10/15/87	3	197B	285	200B	0
10/16/87	4	211B	1800	212B	0
10/19/87	7	219B	1889	220B	0.1
10/20/87	8	231B	1200	232B	0.3
10/21/87	9	244B	1000	245B	0.3
10/22/87	10	252B	1000	255B	0.3
10/23/87	11	260B	2100	267B	0
10/26/87	14	273B	1000	278B	0.8
10/27/87	15	285B	1300	286B	0.8
10/28/87	16	295B	1500	296B	0.5
10/29/87	17	307B	1400	309B	0.8
10/30/87	18	318B	1500	319B	0.7
11/02/87	21	328B	1200	329B	0.9
11/03/87	22	336B	1300	337B	2.8
11/04/87	23	NS		NS	
11/05/87	24	354B	1200	NS	
11/06/87	25	365B	1200	366B	3.7
11/09/87	28	376B	1200	377B	1.2
11/10/87	29	NS		386B	1.4
11/11/87	30	400B	970	401B	1.3
11/12/87	31	421B	1000	424B	1
11/13/87	32	432B	1000	433B	1.3

NS = No Sample

Source: DataChem

TABLE A.9 (CONTINUED)

DBP Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DBP (ppb)	Effluent Sample Number	Effluent DBP (ppb)
11/16/87	35	452B	650	453B	2.7
11/17/87	36	460B	560	461B	0.8
11/18/87	37	472B	680	473B	1.8
11/19/87	38	490B	890	491B	1.6
11/20/87	39	501B	1000	502B	0
11/23/87	42	511B	1000	512B	Br
11/24/87	43	522B	800	523B	0
11/25/87	44	535B	1200	536B	1.7
11/26/87	45	544B	810	545B	1.1
11/27/87	46	554B	760	557B	0.8
11/30/87	49	569B	36	570B	1.2
12/01/87	50	584B	790	585B	0
12/02/87	51	602B	0	603B	0
12/03/87	52	612B	53	613B	0
12/04/87	53	627B	1000	628B	1.3
12/07/87	56	637B	1200	638B	0
12/08/87	57	646B	1000	647B	0
12/09/87	58	661B	680	662B	0
12/10/87	59	671B	0	672B	0
12/11/87	60	723B	0	724B	0
12/14/87	63	739B	0	740B	0
12/15/87	64	762B	250	763B	0
12/16/87	65	782B	88	783B	0

Br = Bottle Broken in Transit

Source: DataChem

TABLE A.10

DPA Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DPA (ppb)	Effluent Sample Number	Effluent DPA (ppb)
10/13/87	1	172B	9104	173B	8.5
10/14/87	2	190B	5049	184B	2.8
10/15/87	3	197B	5162	200B	1.4
10/16/87	4	211B	1096	212B	10.8
10/19/87	7	219B	751	220B	2.8
10/20/87	8	231B	490	232B	2.2
10/21/87	9	244B	490	245B	0.7
10/22/87	10	252B	450	255B	0.8
10/23/87	11	260B	1000	267B	5.9
10/26/87	14	273B	1200	278B	78
10/27/87	15	285B	1200	286B	77
10/28/87	16	295B	1300	296B	76
10/29/87	17	307B	1400	309B	20
10/30/87	18	318B	1700	319B	63
11/02/87	21	328B	1800	329B	84
11/03/87	22	336B	1700	337B	47
11/04/87	23	NS		NS	
11/05/87	24	354B	1600	NS	
11/06/87	25	365B	1500	366B	47
11/09/87	28	376B	1200	377B	71
11/10/87	29	NS		386B	89
11/11/87	30	400B	1500	401B	75
11/12/87	31	421B	1500	424B	64
11/13/87	32	432B	1500	433B	57

NS = No Sample

Source: DataChem

Arthur D Little

TABLE A.10 (CONTINUED)

DPA Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DPA (ppb)	Effluent Sample Number	Effluent DPA (ppb)
11/16/87	35	452B	1900	453B	21
11/17/87	36	460B	1600	461B	21
11/18/87	37	472B	1200	473B	22
11/19/87	38	490B	1200	491B	12
11/20/87	39	501B	1800	502B	4.7
11/23/87	42	511B	1900	512B	Br
11/24/87	43	522B	1600	523B	0
11/25/87	44	535B	1800	536B	1.8
11/26/87	45	544B	1800	545B	1.7
11/27/87	46	554B	1600	557B	1.4
11/30/87	49	569B	600	570B	1.4
12/01/87	50	584B	1800	585B	1
12/02/87	51	602B	670	603B	0
12/03/87	52	612B	1200	613B	0
12/04/87	53	627B	1700	628B	2.4
12/07/87	56	637B	2000	638B	0
12/08/87	57	646B	1700	647B	0
12/09/87	58	661B	1900	662B	0
12/10/87	59	671B	1700	672B	0
12/11/87	60	723B	1300	724B	0
12/14/87	63	739B	1700	740B	0
12/15/87	64	762B	2000	763B	0
12/16/87	65	782B	1600	783B	0

Br = Bottle Broken in Transit

Source: DataChem

TABLE A.11

Phosphorous Results for Extended Aeration Without Nitroglycerin

		Inlet		Effluent	
Date (MM/DD/YY)	Day After Startup	Sample Number	P (mg/L)	Sample Number	P (mg/L)
10/12/87	0	158B	1.92	161B	25.5
10/19/87	7	214B	2	218B	1.5
10/23/87	11	262B	2.62		
10/26/87	14	272B	2.7	277B	2.2
11/02/87	21	323B	1.83	327B	1.74
11/09/87	28	371B	7.6	375B	4.4
11/16/87	35	447B	8.5	451B	9.6
11/23/87	42	506B	3.8	510B	3.8
11/30/87	49	564B	7.68	568B	4.54
12/07/87	56	630B	7.84	634B	7.12
12/14/87	63	734B	6.84	738B	5.7

Source: Strand Associates, Inc.

TABLE A.12

SO4 Results for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet SO4 (mg/L)	Effluent Sample Number	Effluent SO4 (mg/L)
10/14/87	2	187B	1230	181B	1240
10/15/87	3	202B	1000		
10/21/87	9	236B	900	239B	1150
10/23/87	11	258B	2100		
10/28/87	16	287B	1780	292B	2100
11/04/87	23	338B	2000	343B	2120
11/11/87	30	392B	2200	397B	2400
11/18/87	37	466B	2500	470B	2280
11/25/87	44	529B	2250	533B	2160
12/02/87	51	590B	2250	595B	1940
12/09/87	58	653B	2040	658B	2200
12/16/87	65	771B	2000	775B	2600

Source: Strand Associates, Inc.

TABLE A.13

Food-to-Mass Ratios for Extended Aeration Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Food-to-Mass Ratio
10/12/87	0	0.096
10/13/87	1	0.121
10/14/87	2	0.103
10/15/87	3	0.082
10/16/87	4	0.206
10/19/87	7	0.163
10/20/87	8	0.181
10/21/87	9	0.147
10/22/87	10	0.213
10/23/87	11	0.207
10/26/87	14	0.201
10/27/87	15	0.200
10/28/87	16	0.175
10/29/87	17	0.135
10/30/87	18	0.192
11/02/87	21	0.203
11/03/87	22	0.176
11/04/87	23	0.131
11/06/87	25	0.190
11/09/87	28	0.252
11/10/87	29	0.210
11/11/87	30	0.246
11/12/87	31	0.190
11/13/87	32	0.166
11/16/87	35	0.157
11/17/87	36	0.184
11/18/87	37	0.182

Source: Arthur D. Little, Inc.

TABLE A.13 (CONTINUED)

Food-to-Mass Ratios for Extended Aeration Without Nitroglycerin (Continued)

Date (MM/DD/YY)	Day After Startup	Food-to-Mass Ratio
11/19/87	38	0.162
11/20/87	39	0.194
11/23/87	42	0.078
11/24/87	43	0.095
11/25/87	44	0.096
11/26/87	45	0.098
11/27/87	46	0.150
11/30/87	49	0.138
12/01/87	50	0.060
12/02/87	51	0.028
12/03/87	52	0.103
12/04/87	53	0.104
12/07/87	56	0.096
12/08/87	57	0.093
12/09/87	58	0.088
12/10/87	59	0.086
12/11/87	60	0.092
12/14/87	63	0.089
12/15/87	64	0.096
12/16/87	65	0.109

Source: Arthur D. Little, Inc.

Appendix B
Sequencing Batch Reactor Raw Data

TABLE OF CONTENTS

TABLE B.1

BOD Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet BOD (mg/L)	Reactor Sample Number	Reactor BOD (mg/L)	Effluent Sample Number	Effluent BOD (mg/L)
1/09/88	1	133D	920	135D	32	137D	32
1/10/88	2	139D	850	141D	72	143D	50
1/11/88	3	151D	650	155D	64	157D	103
1/12/88	4	161D	790	163D	124	165D	149
1/13/88	5	173D	920	175D	182	177D	174
1/14/88	6	186D	1050	188D	38	190D	71
1/15/88	7	199D	740	202D	23	204D	47
1/18/88	10	213D	910	217D	20	219D	55
1/19/88	11	227D	880	229D	20	231D	46
1/20/88	12	239D	900	241D	24	243D	48
1/21/88	13	249D	800	251D	120	253D	98
1/22/88	14	267D	860	269D	20	271D	26
1/25/88	17	277D	740	285D	8	287D	19
1/26/88	18	295D	820	297D	12	299D	14
1/27/88	19	305D	755	307D	7	309D	10
1/28/88	20	315D	788	317D	12	319D	19
1/29/88	21	327D	770	329D	8	331D	22
2/01/88	24	337D	680	339D	15	341D	24
2/02/88	25	353D	980	355D	22	357D	28
2/03/88	26	366D	1040	368D	24	370D	75
2/04/88	27	389D	1040	379D	31	381D	107
2/05/88	28	393D	910	395D	16	397D	64
2/08/88	31	408D	840	410D	10	412D	12
2/09/88	32	426D	910	428D	4	430D	8
2/10/88	33	436D	890	438D	4	440D	4

Source: Strand Associates, Inc.

TABLE B.1 (CONTINUED)

BOD Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet BOD (mg/L)	Reactor Sample Number	Reactor BOD (mg/L)	Effluent Sample Number	Effluent BOD (mg/L)
2/11/88	34	448D	960	450D	11	452D	6
2/12/88	35	462D	800	464D	2	466D	18
2/15/88	38	474D	760	476D	4	478D	6
2/16/88	39	492D	770	494D	11	496D	23
2/17/88	40	504D	840	506D	2	508D	12
2/18/88	41	516D	760	518D	2	520D	7
2/19/88	42	529D	620	531D	2	533D	8
2/22/88	45	541D	630	543D	11	545D	14
2/23/88	46	559D	1050	561D	3	563D	12
2/24/88	47	569D	970	571D	3	573D	10
2/25/88	48	584D	1050	586D	7	588D	6
2/26/88	49	595D	880	597D	5	599D	9
2/29/88	52	611D	880	613D	4	615D	4
3/01/88	53	627D	950	629D	4	631D	7
3/02/88	54	639D	1320	641D	14	643D	7
3/03/88	55	649D	920	651D	3	653D	7
3/04/88	56	669B	830	671D	6	673D	8
3/07/88	59	682D	900	684D	3	686D	14
3/08/88	60	700D	940	704D	2	702D	16
3/09/88	61	712D	980	714D	2	718D	12
3/10/88	62	726D	1220	729D	5	733D	13
3/11/88	63	740D	780	742D	3	746D	9
3/14/88	66	754D	820	758D	6	762D	9
3/15/88	67	776D	840	778D	2	782D	4
3/16/88	68	790D	860	795D	5	797D	8

Source: Strand Associates, Inc.

TABLE B.1 (CONTINUED)

BOD Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet		Reactor		Effluent	
		Sample Number	BOD (mg/L)	Sample Number	BOD (mg/L)	Sample Number	BOD (mg/L)
3/17/88	69	805D	736	807D	2	809D	9
3/18/88	70	820D	840	822D	2.7	826D	10
3/21/88	73	837D	714	839D	7	843D	8
3/22/88	74	857D	980	859D	3	861D	10
3/23/88	75	870D	1110	872D	5	876D	9
3/24/88	76	892D	860	889D	6	894D	11
3/25/88	77	908D	920	910D	4	912D	10
3/28/88	80	922D	770	924D	4	928D	9
3/29/88	81	954D	770	956D	2	958D	5
3/30/88	82	971D	800	973D	2	975D	5
3/31/88	83	989D	740	991D	2	993D	5
4/01/88	84	1003D	790	1005D	2	1007D	6
4/04/88	87	1019D	690	1021D	6	1023D	10
4/05/88	88	1043D	1510	1045D	5	1047D	7
4/06/88	89	1055D	1420	1057D	3	1059D	9
4/07/88	90	1071D	1590	1073D	6	1075D	9
4/08/88	91	1084D	820	1086D	4	1088D	4
4/11/88	94	1102D	760	1104D	2	1106D	10
4/12/88	95	1122D	640	1124D	2	1126D	12
4/13/88	96	1132D	740	1134D	5	1138D	17
4/14/88	97	1150D	684	1152D	10	1159D	19
4/15/88	98	1163D	660	1165D	4	1169D	13
4/18/88	101	1177D	638	1179D	2	1183D	6
4/19/88	102	1197D	622	1199D	2	1203D	5
4/20/88	103	1209D	510	1211D	2	1215D	7

Source: Strand Associates, Inc.

TABLE B.1 (CONTINUED)

BOD Results for Sequencing Batch Reactor Without Nitroglycerin

		Inlet		Reactor		Effluent	
Date (MM/DD/YY)	Day After Startup	Sample Number	BOD (mg/L)	Sample Number	BOD (mg/L)	Sample Number	BOD (mg/L)
4/21/88	104	1227D	1100	1229D	3	1233D	26
4/22/88	105	1242D	1000	1244D	4	1248D	8
4/25/88	108	1254D	400	1256D	2	1260D	4
4/26/88	109	1274D	550	1276D	4	1280D	6.5
4/27/88	110	1286D	610	1288D	2	1292D	11
4/28/88	111	1302D	532	1304D	2	1308D	3
4/29/88	112	1317D	550	1319D	2	1323D	12

Source: Strand Associates, Inc.

TABLE B.1 (CONTINUED)

Change in BOD During Five Day Holding Period

Week End Date MM/DD/YY	Initial BOD mg/L	Final BOD mg/L	Percent Reduction
1/25/88	900	740	18
2/1/88	820	680	17
2/8/88	1040	840	19
2/15/88	890	760	15
2/22/88	840	630	25
2/29/88	1050	880	16
3/7/88	1320	900	32
3/14/88	980	820	16
3/21/88	860	714	17
3/28/88	1110	770	31
4/4/88	800	690	14
4/11/88	1420	760	46
4/18/88	740	638	14
4/25/88	622	400	36
AVERAGE	957	730	23

Source: Strand Associates, Inc.

TABLE B.2

COD Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet COD (mg/L)	Reactor Sample Number	Reactor COD (mg/L)	Effluent Sample Number	Effluent COD (mg/L)
1/09/88	1	134D	1440	136D	158	138D	117
1/10/88	2	140D	1430	142D	212	144D	137
1/11/88	3	153D	1385	156D	212	158D	225
1/12/88	4	162D	1100	164D	280	166D	311
1/13/88	5	174D	1390	176D	264	178D	258
1/14/88	6	187D	1400	189D	155	191D	160
1/15/88	7	201D	1225	203D	98	205D	150
1/18/88	10	215D	1444	218D	144	220D	200
1/19/88	11	228D	1440	230D	122	232D	127
1/20/88	12	240D	1310	242D	180	244D	142
1/21/88	13	250D	1250	252D	120	254D	98
1/22/88	14	268D	1120	270D	139	272D	76
1/25/88	17	281D	1020	286D	300	288D	63
1/26/88	18	296D	1238	298D	199	300D	63
1/27/88	19	306D	1220	308D	180	310D	72
1/28/88	20	316D	1170	318D	218	320D	72
1/29/88	21	328D	1205	330D	320	332D	50
2/01/88	24	338D	908	340D	208	342D	67
2/02/88	25	354D	1480	356D	380	358D	86
2/03/88	26	367D	1498	369D	326	371D	165
2/04/88	27	390D	1430	380D	342	382D	167
2/05/88	28	394D	1465	396D	155	398D	131
2/08/88	31	409D	1260	411D	138	413D	76
2/09/88	32	427D	1383	429D	96	431D	43
2/10/88	33	437D	1351	439D	108	441D	40

Source: Strand Associates, Inc.

TABLE B.2 (CONTINUED)

COD Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet COD (mg/L)	Reactor Sample Number	Reactor COD (mg/L)	Effluent Sample Number	Effluent COD (mg/L)
2/11/88	34	449D	1312	451D	110	453D	39
2/12/88	35	463D	1250	465D	112	467D	50
2/15/88	38	475D	1195	477D	70	479D	45
2/16/88	39	493D	1150	495D	146	497D	42
2/17/88	40	505D	1130	507D	103	509D	39
2/18/88	41	517D	1150	519D	136	521D	45
2/19/88	42	530D	1170	532D	136	534D	42
2/22/88	45	542D	848	544D	160	546D	35
2/23/88	46	560D	1460	562D	146	564D	33
2/24/88	47	570D	1510	572D	197	574D	35
2/25/88	48	585D	1399	587D	205	589D	32
2/26/88	49	596D	1350	598D	155	600D	30
2/29/88	52	612D	1180	614D	114	616D	27
3/01/88	53	628D	1515	630D	177	632D	36
3/02/88	54	640D	1540	642D	171	644D	31
3/03/88	55	650D	1275	652D	171	654D	28
3/04/88	56	670D	1170	672D	24	674D	37
3/07/88	59	683D	1215	685D	40	687D	72
3/08/88	60	701D	1385	703D	64	705D	36
3/09/88	61	713D	1450	717D	33	719D	54
3/10/88	62	728D	1370	732D	31	734D	53
3/11/88	63	741D	1210	745D	26	747D	41
3/14/88	66	756D	1100	761D	23	763D	37
3/15/88	67	777D	1190	779D	28	783D	41
3/16/88	68	791D	1204	796D	31	798D	35

Source: Strand Associates, Inc.

TABLE B.2 (CONTINUED)

COD Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet COD (mg/L)	Reactor Sample Number	Reactor COD (mg/L)	Effluent Sample Number	Effluent COD (mg/L)
3/17/88	69	806D	1180	808D	34	810D	36
3/18/88	70	821D	1153	823D	27	827D	42
3/21/88	73	838D	1034	840D	23	844D	40
3/22/88	74	858D	1400	860D	31	862D	46
3/23/88	75	871D	1450	873D	27	877D	46
3/24/88	76	893D	1370	888D	20	895D	39
3/25/88	77	909D	1300	911D	26	913D	33
3/28/88	80	923D	1010	925D	26	929D	43
3/29/88	81	955D	1235	957D	28	969D	32
3/30/88	82	972D	1230	974D	23	976D	34
3/31/88	83	990D	1136	992D	28	994D	35
4/01/88	84	1004D	1107	1006D	23	1008D	6
4/04/88	87	1020D	980	1022D	26	1024D	31
4/05/88	88	1044D	1999	1046D	31	1048D	40
4/06/88	89	1056D	2370	1057D	26	1060D	41
4/07/88	90	1072D	1960	1074D	30	1076D	38
4/08/88	91	1085D	1010	1087D	23	1089D	33
4/11/88	94	1103D	965	1105D	23	1107D	47
4/12/88	95	1123D	1065	1124D	21	1127D	50
4/13/88	96	1133D	1060	1134D	31	1139D	60
4/14/88	97	1151D	1025	1152D	34	1160D	59
4/15/88	98	1164D	1035	1165D	29	1170D	55
4/18/88	101	1178D	1040	1179D	33	1184D	43
4/19/88	102	1198D	930	1199D	29	1204D	46
4/20/88	103	1210D	802	1211D	22	1216D	60

Source: Strand Associates, Inc.

TABLE B.2 (CONTINUED)

COD Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet		Reactor		Effluent	
		Sample Number	COD (mg/L)	Sample Number	COD (mg/L)	Sample Number	COD (mg/L)
4/21/88	104	1228D	1478	1229D	17	1234D	314
4/22/88	105	1243D	1480	1244D	24	1249D	39
4/25/88	108	1255D	780	1256D	19	1261D	32
4/26/88	109	1275D	737	1276D	12	1281D	32
4/27/88	110	1287D	737	1288D	24	1293D	18
4/28/88	111	1303D	756	1304D	34	1309D	20
4/29/88	112	1318D	865	1319D	13	1324D	43

Source: Strand Associates, Inc.

TABLE B.2 (CONTINUED)

Change in COD During Five Day Holding Period

Week End Date MM/DD/YY	Initial COD mg/L	Final COD mg/L	Percent Reduction
1/25/88	1310	1020	22
2/1/88	1220	908	26
2/8/88	1498	1260	16
2/15/88	1351	1195	12
2/22/88	1130	848	25
2/29/88	1510	1180	22
3/7/88	1540	1215	21
3/14/88	1450	1100	24
3/21/88	1220	1034	15
3/28/88	1450	1010	30
4/4/88	1230	980	20
4/11/88	2370	965	59
4/18/88	1060	1040	2
4/25/88	930	780	16
AVERAGE	1376	1038	22

Source: Strand Associates, Inc.

TABLE B.3

MLSS Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet		Reactor		Effluent	
		Sample Number	TSS (mg/L)	Sample Number	MLSS (mg/L)	Sample Number	TSS (mg/L)
1/09/88	1	133D	41	135D	4142	137D	53
1/10/88	2	139D	42	141D	4614	143D	45
1/11/88	3	151D	32	155D	4658	157D	64
1/12/88	4	NS		163D	3890	165D	83
1/13/88	5	173D	33	175D	5040	177D	95
1/14/88	6	NS		188D	4990	190D	54
1/15/88	7	199D	29	202D	4400	204D	46
1/18/88	10	213D	18	217D	4660	219D	100
1/19/88	11	NS		229D	4790	231D	50
1/20/88	12	239D	20	241D	4210	243D	51
1/21/88	13	NS		251D	4210	253D	4
1/22/88	14	267D	25	269D	4440	271D	22
1/25/88	17	277D	17	285D	4830	287D	16
1/26/88	18	NS		297D	5540	299D	21
1/27/88	19	305D	30	307D	4690	309D	72
1/28/88	20	NS		317D	5100	319D	27
1/29/88	21	327D	38	329D	5260	331D	26
2/01/88	24	337D	37	339D	3680	341D	22
2/02/88	25	NS		355D	4433	357D	12
2/03/88	26	366D	24	368D	4510	370D	41
2/04/88	27	NS		379D	4312	381D	51
2/05/88	28	393D	55	395D	4340	397D	40
2/08/88	31	408D	70	410D	4380	412D	32
2/09/88	32	NS		428D	4125	NS	
2/10/88	33	436D	30	438D	4510	440D	15

NS = No Sample

Source: Strand Associates, Inc.

Arthur D Little

TABLE B.3 (CONTINUED)

MLSS Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet TSS (mg/L)	Reactor Sample Number	Reactor MLSS (mg/L)	Effluent Sample Number	Effluent TSS (mg/L)
2/11/88	34	NS		450D	4580	NS	
2/12/88	35	462D	36	464D	3390	466D	12
2/15/88	38	474D	50	476D	4378	478D	12
2/16/88	39	NS		494D	4170	NS	
2/17/88	40	504D	49	506D	3980	508D	11
2/18/88	41	NS		518D	4100	520D	10
2/19/88	42	529D	58	531D	4510	533D	8
2/22/88	45	541D	41	543D	4310	545D	14
2/23/88	46	NS		561D	4390	563D	17
2/24/88	47	569D	40	571D	4688	573D	16
2/25/88	48	NS		586D	4925	588D	13
2/26/88	49	595D	36	597D	4520	599D	14
2/29/88	52	611D	44	613D	4477	615D	12
3/01/88	53	NS		629D	4860	631D	19
3/02/88	54	639D	35	641D	4530	643D	16
3/03/88	55	NS		651D	3675	653D	19
3/04/88	56	669D	31	671D	4630	673D	14
3/07/88	59	682D	24	684D	4378	686D	30
3/08/88	60	NS		704D	4400	702D	30
3/09/88	61	712D	24	714D	4420	718D	10
3/10/88	62	NS		729D	4560	733D	22
3/11/88	63	740D	38	742D	4050	746D	33
3/14/88	66	754D	36	758D	4480	762D	26
3/15/88	67	NS		778D	4370	782D	10
3/16/88	68	790D	26	795D	4930	797D	12

NS = No Sample

Source: Strand Associates, Inc.

Arthur D Little

TABLE B.3 (CONTINUED)

MLSS Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet TSS (mg/L)	Reactor Sample Number	Reactor MLSS (mg/L)	Effluent Sample Number	Effluent TSS (mg/L)
3/17/88	69	NS		807D	4920	809D	8
3/18/88	70	820D	26	822D	4510	826D	18
3/21/88	73	837D	24	839D	4710	843D	20
3/22/88	74	NS		859D	4750	861D	15
3/23/88	75	870D	20	872D	4760	876D	8
3/24/88	76	NS		889D	4020	894D	10
3/25/88	77	908D	17	910D	4440	912D	11
3/28/88	80	922D	35	924D	4720	928D	12
3/29/88	81	NS		956D	4540	958D	3
3/30/88	82	971D	32	973D	4240	975D	5
3/31/88	83	NS		991D	4610	993D	7
4/01/88	84	1003D	21	1005D	4567	1007D	7
4/04/88	87	1019D	19	1021D	4422	1023D	12
4/05/88	88	NS		1045D	4840	1047D	12
4/06/88	89	1055D	39	1057D	5553	1059D	8
4/07/88	90	NS		1073D	5788	1075D	10
4/08/88	91	1084D	38	1086D	5690	1088D	12
4/11/88	94	1102D	26	1104D	5460	1106D	16
4/12/88	95	NS		1125D	5600	1126D	28
4/13/88	96	1132D	24	1135D	5080	1138D	33
4/14/88	97	NS		1153D	4830	1159D	24
4/15/88	98	1163D	38	1166D	4520	1169D	14
4/18/88	101	1177D	22	1180D	4380	1183D	16
4/19/88	102	NS		1200D	4255	1203D	11
4/20/88	103	1209D	8	1212D	4630	1215D	15

NS = No Sample

Source: Strand Associates, Inc.

TABLE B.3 (CONTINUED)

MLSS Results for Sequencing Batch Reactor Without Nitroglycerin

		Inlet		Reactor		Effluent	
Date (MM/DD/YY)	Day After Startup	Sample Number	TSS (mg/L)	Sample Number	MLSS (mg/L)	Sample Number	TSS (mg/L)
4/21/88	104	NS		1230D	4940	1233D	60
4/22/88	105	1242D	18	1245D	5113	1248D	28
4/25/88	108	1254D	18	1257D	5590	1260D	23
4/26/88	109	NS		1277D	5867	1280D	14
4/27/88	110	1286D	12	1289D	5805	1292D	38
4/28/88	111	NS		1305D	5110	1308D	10
4/29/88	112	1317D	20	1320D	5340	1323D	34

NS = No Sample

Source: Strand Associates, Inc.

TABLE B.4

MLVSS Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Sample Number	MLVSS (mg/L)
1/09/88	1	135D	3282
1/10/88	2	141D	3408
1/11/88	3	155D	3695
1/12/88	4	163D	2978
1/13/88	5	175D	3810
1/14/88	6	188D	3760
1/15/88	7	202D	3380
1/18/88	10	217D	3484
1/19/88	11	229D	3760
1/20/88	12	241D	3230
1/21/88	13	251D	3510
1/22/88	14	269D	3770
1/25/88	17	285D	4150
1/26/88	18	297D	4905
1/27/88	19	307D	3952
1/28/88	20	317D	4625
1/29/88	21	329D	4550
2/01/88	24	339D	3076
2/02/88	25	355D	3850
2/03/88	26	368D	3830
2/04/88	27	379D	4312
2/05/88	28	395D	3745
2/08/88	31	410D	3710
2/09/88	32	428D	3575
2/10/88	33	438D	3850
2/11/88	34	450D	3828
2/12/88	35	464D	2900

Source: Strand Associates, Inc.

TABLE B.4 (CONTINUED)

MLVSS Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Sample Number	MLVSS (mg/L)
2/15/88	38	476D	3825
2/16/88	39	494D	3460
2/17/88	40	506D	3390
2/18/88	41	518D	3580
2/19/88	42	531D	4140
2/22/88	45	543D	3650
2/23/88	46	561D	3640
2/24/88	47	571D	3975
2/25/88	48	586D	4200
2/26/88	49	597D	3710
2/29/88	52	613D	3970
3/01/88	53	629D	4325
3/02/88	54	641D	4080
3/03/88	55	651D	3280
3/04/88	56	671D	3980
3/07/88	59	684D	3730
3/08/88	60	704D	4110
3/09/88	61	714D	3730
3/10/88	62	729D	3740
3/11/88	63	742D	3718
3/14/88	66	758D	4137
3/15/88	67	778D	4370
3/16/88	68	795D	4490
3/17/88	69	807D	4240
3/18/88	70	822D	4110
3/21/88	73	839D	4190
3/22/88	74	859D	4290

Source: Strand Associates, Inc.

TABLE B.4 (CONTINUED)

MLVSS Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Sample Number	MLVSS (mg/L)
3/23/88	75	872D	4040
3/24/88	76	889D	3490
3/25/88	77	910D	4210
3/28/88	80	924D	4275
3/29/88	81	956D	4126
3/30/88	82	973D	3748
3/31/88	83	991D	4140
4/01/88	84	1005D	4253
4/04/88	87	1021D	4210
4/05/88	88	1045D	4600
4/06/88	89	1057D	5040
4/07/88	90	1073D	5475
4/08/88	91	1086D	5330
4/11/88	94	1104D	5050
4/12/88	95	1125D	5030
4/13/88	96	1135D	4830
4/14/88	97	1153D	4440
4/15/88	98	1166D	4340
4/18/88	101	1180D	4030
4/19/88	102	1200D	4260
4/20/88	103	1212D	4410
4/21/88	104	1230D	4620
4/22/88	105	1245D	4740
4/25/88	108	1257D	5330
4/26/88	109	1277D	5533
4/27/88	110	1289D	5320
4/28/88	111	1305D	5110
4/29/88	112	1320D	4910

Source: Strand Associates, Inc.

TABLE B.5

TDS Results for Sequencing Batch Reactor Without Nitroglycerin

		Inlet		Effluent	
Date (MM/DD/YY)	Day After Startup	Sample Number	TDS (mg/L)	Sample Number	TDS (mg/L)
1/09/88	1	133D	3710	137D	3495
1/10/88	2	139D	3600	143D	3570
1/11/88	3	151D	3538	157D	3570
1/13/88	5	173D	3862	177D	3752
1/15/88	7	199D	3785	204D	3485
1/18/88	10	213D	3825	219D	3340
1/20/88	12	239D	3980	243D	3685
1/22/88	14	267D	3790	271D	3540
1/25/88	17	277D	3482	287D	3482
1/27/88	19	305D	3890	309D	3445
1/29/88	21	327D	3440	331D	3362
2/01/88	24	337D	3712	341D	3184
2/03/88	26	366D	4000	370D	3620
2/05/88	28	393D	3710	397D	3620
2/08/88	31	408D	3835	412D	3650
2/10/88	33	436D	3775	440D	3400
2/12/88	35	462D	3695	466D	3495
2/15/88	38	474D	3440	478D	3498
2/17/88	40	504D	3810	508D	3550
2/19/88	42	529D	3918	533D	3592
2/22/88	45	541D	3665	545D	3542
2/24/88	47	569D	3965	573D	3653
2/26/88	49	595D	3690	599D	3620
2/29/88	52	611D	3530	615D	3660
3/02/88	54	639D	3880	643D	3472

Source: Strand Associates, Inc.

TABLE B.5 (CONTINUED)

TDS Results for Sequencing Batch Reactor Without Nitroglycerin

		Inlet		Effluent	
Date (MM/DD/YY)	Day After Startup	Sample Number	TDS (mg/L)	Sample Number	TDS (mg/L)
3/07/88	59	682D	3820	686D	3600
3/09/88	61	712D	3815	718D	3550
3/11/88	63	740D	3860	746D	3200
3/14/88	66	754D	3405	762D	3745
3/16/88	68	790D	3840	797D	3555
3/18/88	70	820D	3745	826D	3555
3/21/88	73	837D	3720	843D	3560
3/22/88	74	857D	NS	861D	NS
3/23/88	75	870D	3680	876D	3560
3/24/88	76	892D	NS	894D	NS
3/25/88	77	908D	3750	912D	3550
3/28/88	80	922D	3855	928D	3626
3/30/88	82	971D	3948	975D	3552
4/01/88	84	1003D	3625	1007D	3490
4/04/88	87	1019D	3918	1023D	3610
4/06/88	89	1055D	3798	1059D	3530
4/08/88	91	1084D	3905	1088D	3530
4/11/88	94	1102D	3855	1106D	3558
4/13/88	96	1132D	3773	1138D	3500
4/15/88	98	1163D	3820	1169D	3530
4/18/88	101	1177D	3675	1183D	3553
4/20/88	103	1209D	3250	1215D	3370
4/22/88	105	1242D	3380	1248D	3280
4/25/88	108	1254D	2845	1260D	2765
4/27/88	110	1286D	3168	1292D	2964
4/29/88	112	1317D	3265	1323D	3020

NS = No Sample

Source: Strand Associates, Inc.

TABLE B.5 (CONTINUED)

Change in TDS During Five Day Holding Period

Week End Date MM/DD/YY	Initial TDS mg/L	Final TDS mg/L	Percent Reduction
1/25/88	3980	3482	12.5
2/1/88	3890	3712	4.6
2/8/88	4000	3835	4.1
2/15/88	3775	3440	8.9
2/22/88	3810	3665	3.8
2/29/88	3965	3530	11
3/7/88	3880	3820	1.5
3/14/88	3815	3405	10.7
3/21/88	3840	3720	3.1
3/28/88	3680	3855	-4.8
4/4/88	3948	3918	0.8
4/11/88	3918	3855	1.6
4/18/88	3773	3675	2.6
4/25/88	3250	2845	12.5
AVERAGE	3823	3626	5.2

Source: Strand Associates, Inc.

TABLE B.6

NH3-N Results for Sequencing Batch Reactor Without Nitroglycerin

		Inlet		Effluent	
Date (MM/DD/YY)	Day After Startup	Sample Number	NH3-N (mg/L)	Sample Number	NH3-N (mg/L)
1/09/88	1	134D	41.3	138D	40
1/11/88	3	153B	52	158B	47.8
1/13/88	5	174D	29.6	178D	43.7
1/15/88	7	200D	30.9	205D	32.7
1/18/88	10	215D	3.7	220D	36.9
1/20/88	12	240D	4.4	244D	13
1/22/88	14	268D	24.1	272D	10.2
1/25/88	17	281D	36.6	288D	25.2
1/27/88	19	306D	24.9	310D	37.6
1/29/88	21	328D	65	332D	52.7
2/01/88	24	338D	61.8	342D	45.7
2/03/88	26	367D	26.5	371D	43.5
2/05/88	28	394D	47.1	398D	30.7
2/08/88	31	409D	64.1	413D	43.8
2/10/88	33	437D	26.6	441D	37.6
2/12/88	35	463D	40.5	467D	15.1
2/15/88	38	475D	68.2	479D	3.5
2/17/88	40	505D	54.2	509D	3.3
2/19/88	42	530D	56.1	534D	0.64
2/22/88	45	542D	68.1	546D	0.65
2/24/88	47	570D	19	574D	0.72
2/26/88	49	596D	26.4	600D	0.64
2/29/88	52	612D	46.6	616D	1.04
3/02/88	54	640D	5.1	644D	0.45
3/04/88	56	670D	15.3	674D	0.24

Source: Strand Associates, Inc.

TABLE B.6 (CONTINUED)

NH3-N Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet NH3-N (mg/L)	Effluent Sample Number	Effluent NH3-N (mg/L)
3/07/88	59	683D	26.3	687D	0.63
3/09/88	61	713D	5.4	719D	0.23
3/11/88	63	741D	9.5	747D	0.3
3/14/88	66	756D	31.8	763D	0.24
3/16/88	68	791D	5.8	798D	0.39
3/18/88	70	821D	24.5	827D	0.36
3/21/88	73	838D	47.1	844D	0.25
3/23/88	75	871D	5.9	877D	0.53
3/25/88	77	909D	10.4	913D	0.19
3/28/88	80	923D	29.4	929D	0.37
3/30/88	82	972D	6.5	976D	0.26
4/01/88	84	1004D	18.4	1008D	0.47
4/04/88	87	1020D	32	1024D	0.41
4/06/88	89	1056D	6.1	1060D	0.56
4/08/88	91	1085D	8.8	1089D	0.27
4/11/88	94	1103D	33.9	1107D	0.33
4/13/88	96	1133D	4.8	1139D	0.24
4/15/88	98	1164D	5.1	1170D	1.15
4/18/88	101	1178D	11.3	1184D	0.34
4/20/88	103	1210D	0.94	1216D	0.52
4/22/88	105	1243D	3.2	1249D	0.29
4/25/88	108	1255D	4.6	1261D	0.19
4/27/88	110	1287D	2.35	1293D	0.18
4/29/88	112	1318D	1.42	1324D	0.31

Source: Strand Associates, Inc.

TABLE B.6 (CONTINUED)

Change in NH3-N During Five Day Holding Period

Week End Date MM/DD/YY	Initial NH3-N mg/L	Final NH3-N mg/L	Percent Increase
1/25/88	4.4	36.6	88
2/1/88	24.9	61.8	60
2/8/88	26.5	64.1	59
2/15/88	26.6	68.2	61
2/22/88	54.2	68.1	20
2/29/88	19	46.6	59
3/7/88	5.1	26.3	81
3/14/88	5.4	31.8	83
3/21/88	5.8	47.1	88
3/28/88	5.9	29.4	80
4/4/88	6.5	32	80
4/11/88	6.1	33.9	82
4/18/88	4.8	11.3	58
4/25/88	0.94	4.6	80
AVERAGE	14	40.1	70

Source: Strand Associates, Inc.

TABLE B.7

NO3-N Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet NO3-N (mg/L)	Effluent Sample Number	Effluent NO3-N (mg/L)
1/14/88	6	195D	0.55	196D	0.37
1/21/88	13	256D	0.68	259D	2.3
1/28/88	20	323D	0.95	324D	0.88
2/04/88	27	387D	1.9	388D	0.62
2/05/88	28	404D	1.1	405D	3.8
2/08/88	31	422D	0.73	423D	5.9
2/10/88	33	444D	1.4	445D	9.3
2/12/88	35	470D	0.93	471D	19
2/15/88	38	487D	0.5	489D	18
2/17/88	40	512D	0.66	513D	17
2/19/88	42	537D	0.68	538D	17
2/22/88	45	555D	0.57	556D	21
2/24/88	47	580D	1.1	581D	11
2/26/88	49	606D	1.1	607D	12
2/29/88	52	625D	0.67	626D	13
3/03/88	55	660D	1.1	661D	9.7
3/04/88	56	679D	1.1	680D	11
3/07/88	59	695D	0.99	697D	16
3/09/88	61	721D	1.3	723D	8.2
3/11/88	63	749D	1.4	751D	9.1
3/14/88	66	769D	1.2	771D	11
3/16/88	68	800D	9.3	802D	0.88
3/18/88	70	832D	0.76	834D	9.4
3/21/88	73	853D	0.6	854D	11
3/23/88	75	880D	1.3	881D	3.6

Source: DataChem

TABLE B.7 (CONTINUED)

NO3-N Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet NO3-N (mg/L)	Effluent Sample Number	Effluent NO3-N (mg/L)
3/25/88	77	916D	1.4	917D	3.4
3/28/88	80	932D	1.1	933D	9.2
3/30/88	82	981D	1.2	982D	8.9
4/01/88	84	1013D	1.1	1014D	8.8
4/04/88	87	1029D	0.89	1030D	10
4/06/88	89	1067D	1.1	1068D	0.49
4/08/88	91	1094D	1.3	1095D	5.9
4/11/88	94	1112D	1.1	1113D	12
4/13/88	96	1145D	1.1	1147D	14
4/15/88	98	1172D	1.2	1174D	14
4/18/88	101	1192D	1.1	1194D	13
4/20/88	103	1218D	0.04	1220D	4
4/22/88	105	NS		NS	
4/25/88	108	1269D	0.03	1271D	10
4/27/88	110	1297D	0.03	1299D	18
4/29/88	112	1329D		1331D	

NS = No Sample

Source: DataChem

TABLE B.7 (CONTINUED)

Change in NO3-N During Five Day Holding Period

Week End Date MM/DD/YY	Initial NO3-N mg/L	Final NO3-N mg/L	Percent Reduction
2/8/88	1.9	0.73	62
2/15/88	1.4	0.5	64
2/22/88	0.66	0.57	14
2/29/88	1.1	0.67	39
3/7/88	1.1	0.99	10
3/14/88	1.3	1.2	8
3/21/88	9.3	0.6	94
3/28/88	1.3	1.1	15
4/4/88	1.2	0.89	26
4/11/88	1.1	1.1	0
4/18/88	1.1	1.1	0
4/25/88	0.04	0.03	25
AVERAGE	1.79	0.79	30

Source: DataChem

TABLE B.8

TKN Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet TKN (mg/L)	Effluent Sample Number	Effluent TKN (mg/L)
1/09/88	1	134D	88	138D	42.2
1/11/88	3	153D	80.6	158D	62.2
1/13/88	5	174D	64	178D	68
1/15/88	7	200D	70.6	205D	42.9
1/18/88	10	215D	59.6	220D	51.5
1/20/88	12	240D	53.7	244D	25.5
1/22/88	14	268D	56.5	272D	17.2
1/25/88	17	281D	49.4	288D	30
1/27/88	19	306D	76.2	310D	44.4
1/29/88	21	328D	78.1	332D	61.8
2/01/88	24	338D	73.6	342D	47.8
2/03/88	26	367D	75.5	371D	50.9
2/05/88	28	394D	81.8	398D	41
2/08/88	31	409D	91.4	413D	50.7
2/10/88	33	437D	82	441D	41.2
2/12/88	35	463D	78.6	467D	18.2
2/15/88	38	474D	73.6	479D	9.9
2/17/88	40	505D	76	509D	4
2/19/88	42	530D	80.3	534D	5.6
2/22/88	45	542D	72.4	546D	6.4
2/24/88	47	570D	75	574D	4.2
2/26/88	49	596D	65.2	600D	2.36
2/29/88	52	612D	67.6	616D	2.78
3/02/88	54	640D	62.3	644D	1.52
3/04/88	56	670D	53.5	674D	1.97

Source: Strand Associates, Inc.

TABLE B.8 (CONTINUED)

TKN Results for Sequencing Batch Reactor Without Nitroglycerin

		Inlet		Effluent	
Date (MM/DD/YY)	Day After Startup	Sample Number	TKN (mg/L)	Sample Number	TKN (mg/L)
3/07/88	59	683D	57.2	687D	5.13
3/09/88	61	713D	51.4	719D	3.68
3/11/88	63	741D	53.3	747D	4.84
3/14/88	66	756D	56.7	763D	2.25
3/16/88	68	791D	66.6	798D	2.56
3/18/88	70	821D	53.8	827D	2.78
3/21/88	73	838D	59.6	844D	2.04
3/23/88	75	871D	63.8	877D	6.7
3/25/88	77	909D	60	913D	7.4
3/28/88	80	923D	64.8	929D	6
3/30/88	82	972D	52.5	976D	5.3
4/01/88	84	1004D	47.4	1008D	5.2
4/04/88	87	1020D	52.5	1024D	6.4
4/06/88	89	1056D	47.5	1060D	2.3
4/08/88	91	1085D	49.2	1089D	2.09
4/11/88	94	1103D	48.1	1107D	2.93

Source: Strand Associates, Inc.

TABLE B.8 (CONTINUED)

Change in TKN During Five Day Holding Period

Week End Date MM/DD/YY	Initial TKN mg/L	Final TKN mg/L	Percent Reduction
1/25/88	54	49	8
2/1/88	76	74	3
2/8/88	76	91	-21
2/15/88	82	74	10
2/22/88	76	72	5
2/29/88	75	68	10
3/7/88	62	57	8
3/14/88	51	57	-10
3/21/88	67	60	11
3/28/88	64	65	-2
4/4/88	53	53	0
4/11/88	48	48	-1
AVERAGE	65	64	2

Source: Strand Associates, Inc.

TABLE B.9

DBP Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DBP (ppb)	Effluent Sample Number	Effluent DBP (ppb)
1/11/88	3	159D	0	160D	0
1/12/88	4	167D	0	168D	0
1/13/88	5	179D	130	180D	0
1/14/88	6	192D	220	193D	0
1/15/88	7	209D	390	210D	0
1/18/88	10	221D	690	222D	0
1/19/88	11	233D	770	234D	0
1/20/88	12	245D	550	246D	0
1/21/88	13	255D	540	258D	0
1/22/88	14	273D	830	274D	0
1/25/88	17	289D	530	290D	0
1/26/88	18	301D	920	302D	0
1/27/88	19	311D	830	312D	0
1/28/88	20	321D	840	322D	0
1/29/88	21	333D	790	334D	0
2/01/88	24	349D	540	350D	0
2/02/88	25	359D	920	362D	0
2/03/88	26	375D	1100	376D	0
2/04/88	27	383D	1000	384D	5.5
2/05/88	28	402D	680	403D	0
2/08/88	31	420D	240	421D	0
2/09/88	32	432D	860	433D	0
2/10/88	33	442D	1100	443D	0
2/11/88	34	454D	1100	455D	0
2/12/88	35	468D	920	469D	0

Source: DataChem

TABLE B.9 (CONTINUED)

DBP Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DBP (ppb)	Effluent Sample Number	Effluent DBP (ppb)
2/15/88	38	486D	410	488D	0
2/16/88	39	498D	810	499D	0
2/17/88	40	510D	1200	511D	0
2/18/88	41	522D	1400	523D	0
2/19/88	42	535D	870	536D	0
2/22/88	45	553D	870	554D	0
2/23/88	46	565D	1400	566D	0
2/24/88	47	578D	1100	579D	0
2/25/88	48	590D	1100	591D	0
2/26/88	49	604D	1400	605D	1.3
2/29/88	52	623D	1500	624D	0
3/01/88	53	633D	1600	634D	1.1
3/02/88	54	645D	900	646D	0
3/03/88	55	656D	830	657D	0
3/04/88	56	675D	500	676D	0
3/07/88	59	694D	340	696D	0
3/08/88	60	706D	Br	707D	0
3/09/88	61	720D	1400	722D	0
3/10/88	62	735D	1200	736D	0
3/11/88	63	748D	1000	750D	0.6
3/14/88	66	768D	790	770D	0
3/15/88	67	784D	960	787D	0
3/16/88	68	799D	1100	801D	1.4
3/17/88	69	811D	1200	812D	0
3/18/88	70	831D	1200	833D	0

Br = Bottle Broken in Transit

Source: DataChem

TABLE B.9 (CONTINUED)

DBP Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DBP (ppb)	Effluent Sample Number	Effluent DBP (ppb)
3/21/88	73	851D	540	852D	0
3/22/88	74	866D	1700	857D	0
3/23/88	75	878D	1300	879D	0
3/24/88	76	896D	1000	897D	0
3/25/88	77	914D	1000	915D	0.6
3/28/88	80	930D	840	931D	0.7
3/29/88	81	962D	1700	963D	0.5
3/30/88	82	979D	840	980D	0
3/31/88	83	997D	880	998D	0
4/01/88	84	1011D	1000	1012D	0.9
4/04/88	87	1027D	930	1028D	0.7
4/05/88	88	1051D	3400	1052D	0
4/06/88	89	1065D	2300	1066D	1.1
4/07/88	90	1079D	2500	1080D	0.8
4/08/88	91	1092D	1100	1093D	0.7
4/11/88	94	1110D	880	1111D	1.4
4/12/88	95	1128D	870	1129D	0.9
4/13/88	96	1144D	720	1146D	0.5
4/14/88	97	1156D	690	1157D	1.1
4/15/88	98	1171D	760	1173D	1.1
4/18/88	101	1191D	900	1193D	0
4/19/88	102	1205D	640	1206D	0.6
4/20/88	103	1217D	180	1219D	10
4/21/88	104	1235D	180	1236D	1.7
4/22/88	105	1250D	350	1251D	0

Source: DataChem

TABLE B.9 (CONTINUED)

DBP Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DBP (ppb)	Effluent Sample Number	Effluent DBP (ppb)
4/25/88	108	1268D	300	1270D	0
4/26/88	109	1282D	800	1283D	0
4/27/88	110	1296D	630	1298D	0
4/28/88	111	1310D	880	1312D	0.7
4/29/88	112	1328D		1330D	

Source: DataChem

TABLE B.9 (CONTINUED)

Change in DBP During Five Day Holding Period

Week End Date MM/DD/YY	Initial DBP ppb	Final DBP ppb	Percent Reduction
1/25/88	770	530	31
2/1/88	830	540	35
2/8/88	920	240	74
2/15/88	860	410	52
2/22/88	1200	870	28
2/29/88	1400	1500	-7
3/7/88	830	340	59
3/14/88	1400	790	44
3/21/88	1100	540	51
3/28/88	1300	840	35
4/4/88	1700	930	45
4/11/88	2300	880	62
4/18/88	870	900	-3
4/25/88	640	300	53
AVERAGE	1151	686	40

Source: DataChem

TABLE B.10

DPA Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DPA (ppb)	Effluent Sample Number	Effluent DPA (ppb)
1/11/88	3	159D	1500	160D	130
1/12/88	4	167D	1200	168D	240
1/13/88	5	179D	1600	180D	230
1/14/88	6	192D	1600	193D	150
1/15/88	7	209D	1800	210D	62
1/18/88	10	221D	2200	222D	1.6
1/19/88	11	233D	2400	234D	11
1/20/88	12	245D	2000	246D	19
1/21/88	13	255D	2000	258D	17
1/22/88	14	273D	1900	274D	22
1/25/88	17	289D	1600	290D	12
1/26/88	18	301D	2100	302D	16
1/27/88	19	311D	2500	312D	17
1/28/88	20	321D	2100	322D	12
1/29/88	21	333D	2100	334D	8.2
2/01/88	24	349D	1500	350D	0
2/02/88	25	359D	1900	362D	36
2/03/88	26	375D	2800	376D	140
2/04/88	27	383D	2300	384D	200
2/05/88	28	402D	1700	403D	38
2/08/88	31	420D	1100	421D	2
2/09/88	32	432D	1700	433D	18
2/10/88	33	442D	1900	443D	0
2/11/88	34	454D	1600	455D	0
2/12/88	35	468D	1800	469D	0

Source: DataChem

TABLE B.10 (CONTINUED)

DPA Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet DPA (ppb)	Effluent Sample Number	Effluent DPA (ppb)
2/15/88	38	486D	1100	488D	0
2/16/88	39	498D	1500	499D	0
2/17/88	40	510D	1500	511D	0
2/18/88	41	522D	1700	523D	1
2/19/88	42	535D	980	536D	0
2/22/88	45	553D	970	554D	0
2/23/88	46	565D	1500	566D	0
2/24/88	47	578D	1400	579D	0
2/25/88	48	590D	1400	591D	0
2/26/88	49	604D	1400	605D	0
2/29/88	52	623D	1700	624D	0
3/01/88	53	633D	1800	634D	0
3/02/88	54	645D	1500	646D	0
3/03/88	55	656D	1700	657D	0
3/04/88	56	675D	1100	676D	0
3/07/88	59	694D	1300	696D	0
3/08/88	60	706D	Br	707D	0
3/09/88	61	720D	1900	722D	0
3/10/88	62	735D	1800	736D	0
3/11/88	63	748D	1600	750D	0
3/14/88	66	768D	1500	770D	0
3/15/88	67	784D	2000	787D	0
3/16/88	68	799D	2600	801D	0
3/17/88	69	811D	2700	812D	0
3/18/88	70	831D	3000	833D	1.8

Br = Bottle Broken in Transit

Source: DataChem

TABLE B.10 (CONTINUED)

DPA Results for Sequencing Batch Reactor Without Nitroglycerin

		Inlet		Effluent	
Date (MM/DD/YY)	Day After Startup	Sample Number	DPA (ppb)	Sample Number	DPA (ppb)
3/21/88	73	851D	1600	852D	1.6
3/22/88	74	866D	2500	867D	46
3/23/88	75	878D	1700	879D	26
3/24/88	76	896D	1600	897D	4.6
3/25/88	77	914D	1600	915D	0
3/28/88	80	930D	1600	931D	0
3/29/88	81	962D	1800	963D	0
3/30/88	82	979D	1400	980D	0
3/31/88	83	997D	1600	998D	0
4/01/88	84	1011D	1400	1012D	1.5
4/04/88	87	1027D	1300	1028D	1
4/05/88	88	1051D	1200	1052D	1.1
4/06/88	89	1065D	1400	1066D	0
4/07/88	90	1079D	1600	1080D	0
4/08/88	91	1092D	1600	1093D	0
4/11/88	94	1110D	1400	1111D	0
4/12/88	95	1128D	1400	1129D	3
4/13/88	96	1144D	1300	1146D	3.9
4/14/88	97	1156D	1200	1157D	5.1
4/15/88	98	1171D	1300	1173D	4.6
4/18/88	101	1191D	1400	1193D	0
4/19/88	102	1205D	1100	1206D	0

Source: DataChem

TABLE B.10 (CONTINUED)

DPA Results for Sequencing Batch Reactor Without Nitroglycerin

		Inlet		Effluent	
Date (MM/DD/YY)	Day After Startup	Sample Number	DPA (ppb)	Sample Number	DPA (ppb)
4/20/88	103	1217D	350	1219D	11
4/21/88	104	1235D	350	1236D	2.4
4/22/88	105	1250D	550	1251D	0
4/25/88	108	1268D	480	1270D	0
4/26/88	109	1282D	620	1283D	0
4/27/88	110	1296D	610	1298D	0
4/28/88	111	1310D	750	1312D	0
4/29/88	112	1328D		1330D	

Source: DataChem

TABLE B.10 (CONTINUED)

Change in DPA During Five Day Holding Period

Week End Date MM/DD/YY	Initial DPA ppb	Final DPA ppb	Percent Reduction
1/25/88	2000	1600	20
2/1/88	2500	1500	40
2/8/88	2800	1100	61
2/15/88	1900	1100	42
2/22/88	1500	970	35
2/29/88	1400	1700	-21
3/7/88	1800	1300	28
3/14/88	1900	1500	21
3/21/88	2600	1600	38
3/28/88	2500	1600	36
4/4/88	1800	1300	28
4/11/88	1400	1400	0
4/18/88	1400	1400	0
4/25/88	1100	480	56
AVERAGE	1900	1325	27

›urce: DataChem

Arthur D Little

TABLE B.11

Phosphorous Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet Sample Number	Inlet P (mg/L)	Effluent Sample Number	Effluent P (mg/L)
1/11/88	3	153B	3.84	158B	5.2
1/18/88	10	215D	6.75	220D	4
1/25/88	17	281D	5	288D	4.25
2/01/88	24	338D	3.5	342D	2.26
2/08/88	31	409D	4.2	413D	0.8
2/15/88	38	475D	4.7	479D	4.4
2/22/88	45	542D	4.5	546D	4
2/29/88	52	612D	1.02	616D	1.04
3/07/88	59	683D	2.74	687D	4.08
3/14/88	66	756D	3.68	763D	0.62
3/21/88	73	838D	1.74	846D	1.29
3/28/88	80	923D	2.58	929D	0.5
4/04/88	87	1020D	0.65	1024D	0.5
4/11/88	94	1103D	0.42	1107D	0.28
4/18/88	101	1178D	0.58	1184D	0.1
4/25/88	108	1255D	0.81	1261D	0.1

Source: Strand Associates, Inc.

TABLE B.12

SO4 Results for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Inlet		Effluent	
		Sample Number	SO4 (mg/L)	Sample Number	SO4 (mg/L)
1/13/88	5	173D	2200	177D	2000
1/20/88	12	239D	2000	243D	2200
1/27/88	19	305D	2250	309D	2130
2/03/88	26	366D	2270	370D	2080
2/10/88	33	436D	2450	440D	2580
2/17/88	40	504D	2000	508D	2200
2/24/88	47	569D	2100	573D	2100
3/02/88	54	639D	2300	643D	2400
3/09/88	61	712D	2200	718D	2200
3/16/88	68	790D	2040	797D	2600
3/23/88	75	870D	2100	876D	2400
3/30/88	82	971D	2000	975D	2080
4/06/88	89	1055D	2500	1059D	2300
4/13/88	96	1132D	2300	1138D	2200
4/20/88	103	1209D	1900	1215D	1900
4/27/88	110	1286D	1800	1292D	1520

Source: Strand Associates, Inc.

TABLE B.13

Food-to-Mass Ratios for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Food-to-Mass Ratio
1/09/88	1	0.22
1/10/88	2	0.18
1/11/88	3	0.14
1/12/88	4	0.20
1/13/88	5	0.18
1/14/88	6	0.21
1/15/88	7	0.17
1/18/88	10	0.20
1/19/88	11	0.18
1/20/88	12	0.21
1/21/88	13	0.19
1/22/88	14	0.19
1/25/88	17	0.15
1/26/88	18	0.15
1/27/88	19	0.16
1/28/88	20	0.15
1/29/88	21	0.15
2/01/88	24	0.18
2/02/88	25	0.22
2/03/88	26	0.23
2/04/88	27	0.24
2/05/88	28	0.10
2/08/88	31	0.10
2/09/88	32	0.11
2/10/88	33	0.10
2/11/88	34	0.10
2/12/88	35	0.12

Source: Arthur D. Little, Inc.

TABLE B.13 (CONTINUED)

Food-to-Mass Ratios for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Food-to-Mass Ratio
2/15/88	38	0.09
2/16/88	39	0.09
2/17/88	40	0.11
2/18/88	41	0.09
2/19/88	42	0.07
2/22/88	45	0.07
2/23/88	46	0.12
2/24/88	47	0.10
2/25/88	48	0.13
2/26/88	49	0.10
2/29/88	52	0.10
3/01/88	53	0.10
3/02/88	54	0.15
3/03/88	55	0.13
3/04/88	56	0.09
3/07/88	59	0.00
3/08/88	60	0.00
3/09/88	61	0.00
3/15/88	67	0.13
3/16/88	68	0.12
3/17/88	69	0.10
3/18/88	70	0.12
3/21/88	73	0.10
3/22/88	74	0.14
3/23/88	75	0.16
3/24/88	76	0.14
3/25/88	77	0.14

Source: Arthur D. Little, Inc.

TABLE B.13 (CONTINUED)

Food-to-Mass Ratios for Sequencing Batch Reactor Without Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Food-to-Mass Ratio
3/28/88	80	0.11
3/29/88	81	0.11
3/30/88	82	0.13
3/31/88	83	0.11
4/01/88	84	0.12
4/04/88	87	0.10
4/05/88	88	0.21
4/06/88	89	0.17
4/07/88	90	0.18
4/08/88	91	0.10
4/11/88	94	0.09
4/12/88	95	0.08
4/13/88	96	0.10
4/14/88	97	0.09
4/15/88	98	0.10
4/18/88	101	0.10
4/19/88	102	0.10
4/20/88	103	0.07
4/22/88	105	0.13
4/25/88	108	0.00
4/26/88	109	0.06
4/27/88	110	0.07
4/28/88	111	0.07
4/29/88	112	0.07

Source: Arthur D. Little, Inc.

TABLE B.14

Ethyl Acetate Results for Sequencing Batch Reactor wihtout Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Sample Number	EA (mg/L)
1/11/88	3	146D	239
1/12/88	4	169D	165
1/13/88	5	171D	359
1/14/88	6	184D	393
1/15/88	7	197D	299
1/18/88	10	211D	450
1/19/88	11	237D	419
1/20/88	12	247D	432
1/21/88	13	265D	368
1/22/88	14	275D	308
1/25/88	17	291D	118
1/26/88	18	293D	255
1/27/88	19	303D	252
1/28/88	20	313D	99
1/29/88	21	325D	123
2/01/88	24	335D	97
2/02/88	25	351D	332
2/03/88	26	364D	322
2/04/88	27	377D	147
2/05/88	28	391D	45
2/08/88	31	406D	42
2/09/88	32	424D	340
2/10/88	33	434D	273
2/11/88	34	446D	273
2/12/88	35	460D	153
2/15/88	38	472D	146
2/16/88	39	490D	117

Source: Arthur D. Little, Inc.

TABLE B.14 (CONTINUED)

Ethyl Acetate Results for Sequencing Batch Reactor wihtout Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Sample Number	EA (mg/L)
2/17/88	40	502D	45
2/18/88	41	514D	56
2/19/88	42	527D	65
2/22/88	45	539D	71
2/23/88	46	557D	398
2/24/88	47	567D	356
2/25/88	48	582D	313
2/26/88	49	593D	222
2/29/88	52	609D	49
3/01/88	53	635D	418
3/02/88	54	647D	386
3/03/88	55	667D	338
3/04/88	56	677D	177
3/07/88	59	698D	123
3/08/88	60	708D	434
3/09/88	61	724D	391
3/10/88	62	737D	336
3/11/88	63	752D	244
3/14/88	66	772D	116
3/15/88	67	774D	332
3/16/88	68	788D	259
3/17/88	69	803D	193
3/18/88	70	818D	112
3/21/88	73	835D	127
3/22/88	74	855D	395
3/23/88	75	868D	345
3/24/88	76	890D	276

Source: Badger AAP, Olin Corporation

TABLE B.14 (CONTINUED)

Ethyl Acetate Results for Sequencing Batch Reactor wihtout Nitroglycerin

Date (MM/DD/YY)	Day After Startup	Sample Number	EA (mg/L)
3/25/88	77	906D	152
3/28/88	80	920D	122
3/29/88	81	966D	323
3/30/88	82	969D	298
3/31/88	83	987D	259
4/01/88	84	1001D	68
4/04/88	87	1017D	89
4/05/88	88	1041D	873
4/06/88	89	1053D	816
4/07/88	90	1069D	670
4/08/88	91	1082D	210
4/11/88	94	1100D	81
4/12/88	95	1120D	205
4/13/88	96	1130D	244
4/14/88	97	1148D	168
4/15/88	98	1161D	182
4/18/88	101	1175D	93
4/19/88	102	1195D	56
4/20/88	103	1207D	305
4/21/88	104	1225D	669
4/22/88	105	1240D	588
4/25/88	108	1252D	125
4/26/88	109	1272D	314
4/27/88	110	1284D	282
4/28/88	111	1300D	160
4/29/88	112	1315D	398

Source: Badger AAP, Olin Corporation

TABLE B.14 (CONTINUED)

Change in Ethyl Acetate During Five Day Holding Period

Week End Date MM/DD/YY	Initial EA mg/L	Final EA mg/L	Percent Reduction
1/25/88	432	118	73
2/1/88	252	97	62
2/8/88	322	42	87
2/15/88	273	146	47
2/22/88	117	71	39
2/29/88	356	49	86
3/7/88	386	127	67
3/14/88	391	116	70
3/21/88	259	127	51
3/28/88	345	122	65
4/4/88	298	89	70
4/11/88	816	81	90
4/18/88	244	93	62
4/25/88	305	125	59
AVERAGE	343	100	66

Source: Badger AAP, Olin Corporation

Appendix C
Design Of Full-Scale Biological Wastewater Treatment Plants

MEMORANDUM

To: A. A. Balasco

cc: J. L. Mahannah (USATHAMA)
R. F. Machacek
J. M. Nystrom

From: R. C. Bowen

Case No.: 54151-10

Date: March 7, 1988

Subject: Design of Full-Scale Biological Wastewater Treatment Plants

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BACKGROUND

Currently, one objective from the pilot-scale testing at Badger AAP is to prepare design criteria that can be used in the engineering/design of a full-scale biological wastewater treatment system for handling ball powder propellant wastewater. The design criteria will be derived based on the results of over eight (8) months of continuous (round-the-clock) pilot-scale testing. On the basis of data provided by Badger AAP personnel and an actual characterization of the wastewater generated in Badger AAP's pilot-scale ball powder production facility, the full-scale treatment facility at Badger AAP would have to treat a hydraulic load of 1.0 to 3.0 MGD and a BOD loading of 10,000 to 20,000 lb BOD/day (inlet BOD of 800 mg/l). The source of the majority of the BOD is ethyl acetate and collagen. The other constituents that would be of major concern are: trace amounts of diphenylamine (DPA), N-nitrosodiphenylamine (N-nitroso DPA), dibutylphthalate (DBP) and nitroglycerin (NG).

During our In-Progress Review Meeting at Badger Army Ammunition Plant (AAP) on February 4, 1988, questions were raised regarding the ability to design a full-scale (3.0 million gal/day) biological wastewater treatment facility based on the data that we were generating in the pilot-scale (40 to 80 gal/day) biological wastewater treatment plant at Badger AAP. Some attendees at the meeting felt that scale-up from pilot data left them with an uneasy feeling. Consequently, we were requested by USATHAMA to contact both vendors and actual operators of biological wastewater treatment systems to obtain information from them concerning scale-up procedures for actual operating facilities.

OBJECTIVE

To alleviate any concerns that the current pilot-scale test results and wastewater characterization may not be sufficient to develop full-scale design criteria, we contacted several vendors who design and install biological oxidation ditches and/or sequencing batch reactors (SBRs) and asked them to provide us with a list of biological treatment plants that they have designed and constructed. We focused on both of these activated

sludge systems, since they are the two that we are actually pilot-scale testing at Badger AAP. Based on these lists, we selected the plants that would most closely represent the proposed full-scale treatment plant at Badger AAP (with respect to hydraulic loading, BOD loading, type BOD, etc.) and placed calls to each facility to discuss any operational or mechanical problems that they had experienced and what, if any, pilot or laboratory studies had been conducted prior to the full-scale design. A summary of the telephone survey is included as Attachment A.

RESULTS

As we have stated previously, the biological oxidation ditch is a more developed technology than the SBR, and this proved true when we were identifying treatment facilities to contact. The majority of the SBRs that are currently in operation are relatively small (0.1 to 0.5 MGD) while the biological oxidation ditches have capacities from 0.1 to 23 MGD. There are several larger SBR treatment facilities, in the 2.0 to 6.0 MGD range, that are under construction, but to date we could locate only two operational facilities that had hydraulic loadings greater than or equal to 3.0 MGD (Table 1).

Sequencing Batch Reactors (SBRs) - Current operating experience at the SBR facilities contacted has been very good with only minor problems occurring during startup. These startup problems have been quickly remedied by the vendors and no further problems have been reported. The ability of the SBRs to meet design removal efficiencies has also been excellent. Because the SBR technology is relatively new, most of the facilities that we contacted had performed laboratory batch tests in a one liter reactor prior to designing a full-scale system.

The two SBR facilities that are most similar to a proposed full-scale SBR at Badger AAP are the Brown & Williams Tobacco facility in Georgia and the Cow Creek Municipal facility in Oklahoma. The SBR at Brown & Williams treats a small waste stream of approximately 0.5 MGD that has a very high BOD loading of 12,500 lb BOD/day. The BOD loading at Brown & Williams is similar to the BOD loading that is expected in the waste stream from Badger AAP. The BOD (3000 mg/l) in Brown & Williams waste stream generally arises from extracted carbohydrates which would be metabolized in a similar manner to the collagen in Badger AAP's waste stream. The treatment facility design was based solely on the anticipated hydraulic and BOD loading of Brown & Williams' waste streams and the vendor's experience in designing SBR treatment facilities; neither laboratory- nor pilot-scale tests were conducted. To date, the Brown & Williams treatment plant has experienced no difficulty in meeting the design removal criteria.

The SBR at the Cow Creek Municipal facility treats approximately 3.0 MGD (design capacity of 6.0 MGD) with a BOD loading of 8000 lb BOD/day. Cow Creek's BOD loading is lower than that antiacipated at Badger AAP, but the hydraulic loading is similar; therefore, the equipment used at Cow Creek would be similar in size to the equipment needed at Badger AAP. The mechanical experience at Cow Creek has been excellent implying that further pilot tasting of SBRs for the reason of testing the reliability of the mechanical systems is unnecessary. In addition, the performance of the SBR has been excellent.

Biological Oxidation Ditches - Oxidation ditches were more common than SBRs; therefore, we were able to limit our interviews to facilities that would closely resemble (in size) a full-scale system at Badger AAP (Table 2). The facilities that we contacted had no problems with either the mechanical systems or their ability to meet design removal efficiencies. In fact, they were extremely pleased with the operation of the systems to date.

Several of the oxidation ditches have BOD loadings (10,000 to 20,000 lb BOD/day) in the predicted range of Badger AAP's (20,000 lb BOD/day) and they have had excellent BOD removal efficiencies. The plant that treats the waste stream most closely resembling Badger AAP's is the Heineken Brewery in Holland. Heineken has a 1.7 MGD waste stream that has a loading of 13,400 lb BOD/day. The 1000 mg/l of BOD in the inlet stream is mostly proteins, starches and sugars and should be biologically metabolized in a manner similar to the BOD in the waste stream (800 mg/l) at Badger AAP. Heineken's oxidation ditch was designed by the vendor based on Heineken's hydraulic and BOD loadings and without testing the wastewater on a laboratory- or pilot-scale. Heineken has had excellent experience with the operation and removal efficiencies of their oxidation ditch.

The mechanical experiences with the biological oxidation ditches have been as good as the operational experiences. All the facilities that we contacted reported having had only minor (or no) problems, with the equipment in the oxidation ditch. Several of these facilities have equipment of a similar size to that required at Badger AAP.

CONCLUSIONS

In general, when speaking with the vendors about scale-up, they felt that they could design either an SBR or a biological oxidation ditch that would meet required removal efficiencies based on the hydraulic and BOD loadings without performing any laboratory- or pilot-scale testing. They did believe, however, that pilot-scale testing was beneficial when there were constituents in the waste stream that had to be removed to very low levels (e.g., DPA and DBP in the case of ball powder production wastewater). In such cases, they were of the opinion that a 5 to 10 gal/day system was sufficient to generate the necessary design criteria for a full-scale design. Our pilot-scale system at Badger AAP operates at 40 to 80 gal/day.

The conclusions that can be drawn from our telephone survey of existing SBR and biological oxidation ditch wastewater treatment facilities are:

1) Most SBRs and biological oxidation ditches for both industrial and municpal wastewater are designed based on the vendors' past experience with waste streams of similar hydraulic and BOD loadings;

2) Laboratory- or pilot-scale tests are beneficial in designing systems when there is some question about the biodegradation of certain unusual constituents in the wastewater; and

3) SBRs and biological oxidation ditches that are designed based on vendors' experience or laboratory tests regularly meet their design removal efficiencies with few, if any, mechanical problems.

Consequently, we conclude the pilot-scale test data being generated at Badger AAP can be used with confidence to design a full-scale biological wastewater treatment system of either a biological oxidation ditch or SBR design.

TABLE 1

FULL-SCALE SEQUENCING BATCH REACTORS

ID No.	Name/Location of Installation	Wastewater Type	Operating Capacity: Hydraulic Loading (MGD)	Operating Capacity: BOD Loading (lb/day)	Unusual Removal Criteria	Design Basis	Startup Date	Operating Experience
1	A.L. Strub/CO	40% Industrial/ 60% Municipal	5.3	6,100	Detergents/ Cornstarch	Vendor Experience[a]	6/86	System had minor equipment problems during startup, but has had no problems since that time.
2	Brown & Williams Tobacco/GA	Tobacco Processing	0.5	12,500	Very High BOD/ Plant Sugars	Vendor Experience[a]	2/87	They have had minor problems with the aerators but no other mechanical problems. Presently, the plant operates at one half of design capacity.
3	Cow Creek POTW/ OK	Municipal	3.0	8,000	None	Vendor Experience[a]	7/86	Excellent performance and operation. The plant had trouble with the decantors during startup but they were repaired under warranty.
4	Town of Harrah POTW/OK	Municipal	0.2	625	None	Vendor Experience[a]	6/87	No mechanical or system problems after startup. A recycle pump seal failed on startup and was replaced under warranty.
5	J.H. Montgomery Mill/SC	Textile Dye	0.2	3,000	Dye Wastes/ High Alkalinity/ High Salt/ Maximum 40 Color Units	Laboratory[b] Tests/ Vendor Experience[a]	Under Con-struction	Vendor has been slow on equipment delivery.
6	Johnson County Industrial Airport/KS	50% Municipal/ 50% Industrial	0.3	250	Grease/ Detergents	Vendor Experience[a]	9/85	No mechanical problems and system meets permit requirements. System now operating above design capacity and may require expansion.
7	Rutter's Dairy/ PA	Dairy	0.1	3,300	High Salts/ Very High BOD/Protein	Vendor Experience[a]	3/88	Winter startup has been impossible due to frozen lines and frozen ground. Startup anticipated this spring.

[a] Vendor's past experience in design/construction of sequencing batch reactors (SBRs).
[b] Five-day respirometer test.
POTW - Publicly-owned treatment works
Source: Arthur D. Little, Inc.

Arthur D Little

TABLE 2

FULL-SCALE BIOLOGICAL OXIDATION DITCHES

ID No.	Name/Location of Installation	Wastewater Type	Operating Capacity: Hydraulic Loading (MGD)	Operating Capacity: BOD Loading (lb/day)	Unusual Removal Criteria	Design Basis	Startup Date	Operating Experience
1	Ashland POTW/ KY	50% Coking/ 50% Municipal	4.5	11,200	SO_4, H_2S	Vendor Experience[a]	1/82	No operational or mechanical problems to date.
2	Brigham POTW/ UT	Municipal	5.0	10,800	None	Vendor Experience[a]	9/87	No operational or mechanical problems to date.
3	Campbellsville POTW/KY	50% Industrial/ 50% Municipal	4.2	10,500	Color	Vendor Experience[a]	1/79	System meets permit requirements but has had a filamentous bacteria problem due to industrial waste. No mechanical problems to date.
4	Corbin POTW/ KY	20% Industrial/ 80% Municipal	2.5	4,200	None	Vendor Experience[a]	6/82	No operational or mechanical problems to date.
5	Dover Township POTW/PA	Municipal	4.0	3,600	None	Vendor Experience[a]	6/87	Excellent nitrogen and BOD removal. Only problem with system was initial cracks in concrete ditch. No mechanical problems to date.
6	Gunnison POTW/CO	Municipal	4.2	13,400	None	Vendor Experience[a]	8/87	The system has worked very well and has met all permit requirements. To date there have been no operational or mechanical problems.
7	Heineken, N.V./ Holland	Brewery	1.7	14,300	Protein/ Starch/ Sugars	Vendor Experience[a]	1/74	No operational or mechanical problems to date.
8	Orem POTW/UT	Municipal	6.7	8,700	NH_3N	Vendor Experience[a]	5/87	No operational or mechanical problems to date.
9	South Valley POTW/UT	25% Industrial/ 75% Municipal	10.0	18,000	Grease/ Oil	Vendor Experience[a]	10/85	Excellent BOD and TSS removal efficiencies. Gear box on agitator failed during startup. No other operational or mechanical problems to date.

[a] Vendor's past experience in design/construction of biological oxidation ditches.
POTW - Publicly owned treatment works
Source: Arthur D. Little, Inc.

ATTACHMENT A

Summary of Telephone Survey

with

Biological Oxidation Treatment Facility Personnel

Arthur D Little

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: A.L. Strub Co.

Name of Person Contacted: Mr. Collins Tel: (901) 885-9144

<u>Information Needed on Treatment Systems</u>

- Type of treatment plant (extended aeration or SBR):
  Sequencing batch reactor

- Name of Vendor:
  Transfield

- Design capacity of treatment plant:
  5.3 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  Detergents and cornstarch

- Type of wastewater treated:
  40% industrial and 60% municipal

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing)
  Vendor experience and review of similar plants

- Year constructed:
  1984

- Year started:
  June, 1986

- Current capacity of treatment plant (both hydraulic and BOD loading):
  4.5 to 6 MGD
  123 mg/l BOD
  6,100 lb BOD/day

- Plant operating experience

  - equipment related:
    They had minor equipment problems requiring adjustments during startup but have had no mechanical problems since that time.

  - ability to meet design criteria:
    The facility's effluent has met the permit requirements every month since the completion of startup.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Brown and Williams Tobacco Co.

Name of Person Contacted: Bob Walcott Tel: (912) 743-0561

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Sequencing batch reactor

- Name of Vendor:
  Aqua Aerobic

- Design capacity of treatment plant:
  0.5 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  None

- Type of wastewater treated:
  Process water (dust, sugars, etc.)

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  None

- Year constructed:
  1986

- Year started:
  February, 1987

- Current capacity of treatment plant (both hydraulic and BOD loading):
  0.5 MGD
  3000 mg/l BOD
  12,500 lb BOD/day

- Plant operating experience

  - equipment related:
    They have had minor problems with the aerators.

  - ability to meet design criteria:
    The system meets permit requirements at present, but due to low influent flows it is only operating at one half of its design loadings.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Cow Creek, OK

Name of Person Contacted: Al Erskine Tel: (405) 691-2537

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Sequencing batch reactor

- Name of Vendor:
  Jet Tech

- Design capacity of treatment plant:
  6.0 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  None

- Type of wastewater treated:
  Municipal

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience

- Year constructed:
  1985-1986

- Year started:
  July, 1986

- Current capacity of treatment plant (both hydraulic and BOD loading)d:
  2.5-3 MGD
  110-160 mg/l BOD
  8,000 lb BOD/day

- Plant operating experience

  - equipment related:
    When the system was first started there was a problem with the decanters. They were repaired under warranty. There have been no problems since that time.

  - ability to meet design criteria:
    The operator thinks the system is the greatest treatment system he has ever seen. The system easily meets all permit requirements.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Town of Harrah, OK

Name of Person Contacted: Larry Bradley Tel: (405) 454-2806

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Sequencing batch reactor

- Name of Vendor:
  Jet Tech

- Design capacity of treatment plant:
  0.375 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  None

- Type of wastewater treated:
  Municipal

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience

- Year constructed:
  1986-1987

- Year started:
  June, 1987

- Current capacity of treatment plant (both hydraulic and BOD loading):
  0.2 MGD
  200 mg/l inlet BOD
  625 lb BOD/day

- Plant operating experience

  - equipment related:
    No problems

  - ability to meet design criteria:
    System meets permit requirements. To date, influent upsets do not disrupt the system from meeting effluent requirements.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: J.H. Montgomery Mill, SC

Name of Person Contacted: Lester Eldge Tel: (803) 461-2281

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Sequencing batch reactor

- Name of Vendor:
  Aqua Aerobic

- Design capacity of treatment plant:
  0.2 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  Dye operation waste
  High alkalinity
  High salt
  40 Color units maximum discharge

- Type of wastewater treated:
  Dye operation

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Designed plant based on BOD
  sample and vendor experience.

- Year constructed:
  1987-1988

- Year started:
  Under construction

- Anticipated capacity of treatment plant (both hydraulic and BOD loading):
  0.2 MGD
  1800 mg/l BOD
  3,000 lb BOD/day

- Plant operating experience

  - equipment related:
    Aqua Aerobic has been slow on equipment delivery.

  - ability to meet design criteria:
    The plant has not started operation.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Johnson County Industrial Airport, KS

Name of Person Contacted: Frank Farnsworth Tel: (913) 782-5335

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Sequencing batch reactor

- Name of Vendor:
  Jet Tech

- Design capacity of treatment plant:
  0.25 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  None

- Type of wastewater treated:
  Industrial with grease and detergents from margarine plant and municipal.

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience

- Year constructed:
  1984-1985

- Year started:
  September, 1985

- Current capacity of treatment plant (both hydraulic and BOD loading):
  0.3 MGD
  250 lb BOD/day

- Plant operating experience

  - equipment related:
    No problems

  - ability to meet design criteria:
    System meets permit requirements but will have to be expanded to meet new anticipated higher loadings.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Rutter's Dairy, PA

Name of Person Contacted: Don Maulks Tel: (717) 848-9827

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Sequencing batch reactor

- Name of Vendor :
  Aqua Aerobic

- Design capacity of treatment plant:
  0.1 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  None

- Type of wastewater treated:
  Dairy (whey and grease)

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience

- Year constructed:
  1987

- Year started:
  December, 1987

- Current capacity of treatment plant (both hydraulic and BOD loading):
  0.1 MGD
  4000 mg/l BOD
  3,300 lb BOD/day

- Plant operating experience

  - equipment related:
    No problems

  - ability to meet design criteria:
    Plant has not started due to frozen ground and frozen lines.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Ashland, KY

Name of Person Contacted: Jim Smith Tel: (606) 237-201

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Extended aeration

- Name of Vendor:
  EIMCO Carrousel

- Design capacity of treatment plant:
  11.0 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  Hydrogen sulfide and sulfates

- Type of wastewater treated:
  50% Coke plant and 50% municipal

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Laboratory tests and vendor experience

- Year constructed:
  1980-1982

- Year started:
  1982

- Current capacity of treatment plant (both hydraulic and BOD loading):
  4.5 MGD
  250-300 mg/l BOD
  11,200 lb BOD/day

- Plant operating experience

  - equipment related:
    No problems

  - ability to meet design criteria:
    The system meets permit requirements easily, and the operator is very satisfied with the operation of the system.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Brigham City, UT

Name of Person Contacted: John Adams Tel: (801) 734-2001

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Extended aeration

- Name of Vendor:
  EIMCO Carrousel

- Design capacity of treatment plant:
  4.0 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  None

- Type of wastewater treated:
  Municipal

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Review of similar plant's operation in South Valley, UT and vendor experience.

- Year constructed:
  1985-1987

- Year started:
  September, 1987

- Current capacity of treatment plant (both hydraulic and BOD loading):
  4-6 MGD
  216 mg/l BOD
  10,800 lb BOD/day

- Plant operating experience

  - equipment related:
    No problems

  - ability to meet design criteria:
    The systems meets permit requirements under all conditions.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Campbellsville Water Company, KY

Name of Person Contacted: Steve Scags Tel: (502) 465-8376

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Extended aeration

- Name of Vendor:
  EIMCO Carrousel

- Design capacity of treatment plant:
  4.2 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  Color treatment using Super Chlorination (20 mg/l Cl feed)

- Type of wastewater treated:
  50% municipal waste and 50% industrial

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience and was first in the Country

- Year constructed:
  1977

- Year started:
  January, 1979

- Current capacity of treatment plant (both hydraulic and BOD loading):
  4.2 MGD
  300 mg/l BOD
  10,500 lb BOD/day

- Plant operating experience

  - equipment related:
    No problems

  - ability to meet design criteria:
    The system meets permit requirements but had a problem with filamentous bacteria due to industrial waste.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Corbin Wastewater Treatment Plant, KY

Name of Person Contacted: Luke Muncie   Tel: (606) 528-4040

<u>Information Needed on Treatment Systems</u>

- Type of treatment plant (extended aeration or SBR):
  Extended aeration

- Name of Vendor:
  EIMCO Carrousel

- Design capacity of treatment plant:
  4.5 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  None

- Type of wastewater treated:
  80% municipal and 20% industrial

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience

- Year constructed:
  1982

- Year started:
  1982

- Current capacity of treatment plant (both hydraulic and BOD loading):
  2-2.5 MGD
  200 mg/l BOD
  4,200 lb BOD/day

- Plant operating experience

  - equipment related:
    No operational problems and minimum maintenance required.

  - ability to meet design criteria:
    This is the best system in the area. It meets all permit requirements continuously.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Dover Township, PA

Name of Person Contacted: Burton Curry Tel: (717) 846-4614

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Extended aeration

- Name of Vendor:
  EIMCO Carrousel

- Design capacity of treatment plant:
  3.5 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  95% municipal and 5% industrial

- Type of wastewater treated:
  Municipal

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience

- Year constructed:
  1986-1986

- Year started:
  June, 1987

- Current capacity of treatment plant (both hydraulic and BOD loading):
  3-5 MGD
  124 mg/l BOD
  3600 lb BOD/day

- Plant operating experience
  - equipment related:
    The plant has had no problems with the equipment, but it developed cracks in the concrete ditches that had to be repaired after startup.
  - ability to meet design criteria:
    The plant easily meets permit requirements, and the operator is very impressed with the process.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Gunnison, Co.

Name of Person Contacted: Brett Spore   Tel: (303) 641-6416

<u>Information Needed on Treatment Systems</u>

- Type of treatment plant (extended aeration or SBR):
  Extended aeration

- Name of Vendor:
  EIMCO Carrousel

- Design capacity of treatment plant:
  6.3 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  None

- Type of wastewater treated:
  Municipal

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience

- Year constructed:
  1985

- Year started:
  August, 1987

- Current capacity of treatment plant (both hydraulic and BOD loading):
  4.2 MGD
  100-250 mg/l BOD
  13,400 lb BOD/day

- Plant operating experience

  - equipment related:
    No problems encountered to date.

  - ability to meet design criteria:
    The system has worked very well and meets all of its permit requirements.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Heineken, N.V., Holland

Name of Person Contacted: Mr. Keijhoug Tel: 011-31-20-709111

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Extended aeration

- Name of Vendor:
  EIMCO Carrousel

- Design capacity of treatment plant:
  1.7 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  Protein, starch and sugar

- Type of wastewater treated:
  Brewery

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience

- Year constructed:
  1972-1974

- Year started:
  1974

- Current capacity of treatment plant (both hydraulic and BOD loading):
  1.7 MGD
  1,000 mg/l BOD
  14,300 lb BOD/day

- Plant operating experience

  - equipment related:
    No problems

  - ability to meet design criteria:
    The system meets all permit requirements, and the operator drinks the effluent once or twice a week.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: Orem, UT

Name of Person Contacted: Keith Scott Tel: (801) 224-7117

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Extended aeration

- Name of Vendor:
  EIMCO Carrousel

- Design capacity of treatment plant:
  6.7 MGD

- Any unusual removal criteria (NO_3, toxic compound, etc.):
  Pretreatment to control toxics and NH_3

- Type of wastewater treated:
  Municipal

- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vendor experience

- Year constructed:
  1986

- Year started:
  May, 1987

- Current capacity of treatment plant (both hydraulic and BOD loading):
  6.7 MGD
  156 ppm BOD
  8,700 lb BOD/day

- Plant operating experience

  - equipment related:
    The plant operation has been excellent with no maintenance problems.

  - ability to meet design criteria:
    The plant meets the permit requirements easily and almost runs itself.

TELEPHONE CONVERSATION WITH USER OF
BIOLOGICAL OXIDATION TREATMENT FACILITY

Name of User: South Valley, UT

Name of Person Contacted: Willey DeVault Tel: (801) 566-7711

Information Needed on Treatment Systems

- Type of treatment plant (extended aeration or SBR):
  Extended aeration
- Name of Vendor:
  EIMCO Carrousel
- Design capacity of treatment plant:
  12.8 MGD
- Any unusual removal criteria (NO_3, toxic compound, etc.):
  None
- Type of wastewater treated:
  Municipal with minor industries including a semi-conductor and a dog food manufacturer.
- Design basis for scale-up of treatment plant (lab- or pilot-scale testing):
  Vender experience
- Year constructed:
  1984-1985
- Year started;
  October, 1985
- Current capacity of treatment plant (both hydraulic and BOD loading):
  8-12 MGD
  169 mg/l BOD
  18,000 lb BOD/day
- Plant operating experience
  - equipment related:
    One gear box failed during startup and was repaired under warranty
  - ability to meet design criteria:
    Very good performance; meets the permit requirements continuously.

Appendix D
Quality Control Report

TABLE OF CONTENTS

QUALITY CONTROL REPORT

1.0 Introduction

During this pilot test program, both influent and effluent water samples were taken from the biological reactor for analyses. In addition, a limited number of biological sludge samples were analyzed. Three laboratories performed the analyses on these samples. Conventional parameters (e.g., BOD, COD, NH3-N, Total-P, SO_4) were analyzed by Strand Associates (Madison, Wisconsin); DPA, DBP and Nitrate plus Nitrite (N) analyses were performed by DataChem (Salt Lake City, Utah); and ethyl acetate analyses (EA) were performed at the Badger AAP Laboratory.

2.0 Analytes and Analytical Procedures

The analytes and analytical procedures used in this program are summarized in Table 1. DataChem performed analyses of diphenylamine (DPA), dibutylphthalate (DBP) and nitrate according to USATHAMA certified procedures (USATHAMA QA Program, December 1985, 2nd edition, March 1987). DataChem Certification USATHAMA Method Numbers are given in Table 1. The analyte of interest, n-Nitrosodiphenylamine, was not directly analyzed since it converts to diphenylamine during the analysis process. Thus, results throughout this report were given as diphenylamine (DPA) concentrations which represent the sum total of N-nitrosodiphenylamine and diphenylamine in the samples.

3.0 Quality Control Samples

Strand Associates

The analytical results of two types of quality control samples were monitored to check the quality of data produced by Strand Associates during the conduct of their analytical program. The first represented quality control samples internally generated by Strand Associates. The

TABLE 1

ANALYTES AND ANALYTICAL PROCEDURES

Analyte	Procedure[1]	Laboratory
Ammonia-N (NH3-N)	Method 350.2	Strand
Total Kjeldal Nitrogen (TKN)	Method 351.3	Strand
Chemical Oxygen Demand (DOD)	Method 410.1	Strand
Biological Oxygen Demand (BOD)	Method 507	Strand
Total Phosphorus (Total-P)	Method 365.3	Strand
Sulfate (SO4)	Method 375.4	Strand
Dibutylphthalate in water (DPA)	USATHAMA[2]	DataChem (JJ8)[4]
Dibutylphthalate in solids (DPA)	USATHAMA[2]	DataChem (L9)
n-Nitrosodiphenylamine in water	USATHAMA[2]	DataChem (JJ8)
n-Nitrosodiphenylamine in solid	USATHAMA[2]	DataChem (L9)
Nitrate plus Nitrite as N (NO3)	USATHAMA[3]	DataChem (LL8)
Ethyl Acetate (EA)	GC/FID	BAAP

1 Procedures with a Method (and number) refer to methods given in "Methods for Chemical Analysis of Water and Wastes", Environmental Protection Agency, EPA-600/4-79-020, March 1979. Strand is certified by the Wisconsin Department of Natural Resources.

2 The USATHAMA GC/MS Semi Volatile Methods are based on Method 625 given in Federal Register, Volume 49, No. 209, pages 43233-43436, October 29, 1984.

N-nitrosodiphenylamine is analyzed as diphenylamine (DPA) and reported as such throughout this report.

3 Based on Method 353.3 (given in reference * above).

4 Information in () refer to DataChem certification USATHAMA Method Number.

type and number of quality control samples, per analysis is summarized in Table 2. The data for these samples were reported with each batch of results sent to Arthur D. Little; and a representative listing is given in Attachment A. Complete data are available upon request.

The second type of quality control samples were those generated by Arthur D. Little personnel and sent to Strand throughout the program as blind samples. The type and number of these quality control samples is summarized in Table 3 with the results of the analyses provided in Attachment B.

DataChem

The analysis of two types of quality control samples were used to monitor the quality of data produced by DataChem during the conduct of their analyses. The first represented quality control samples internally generated by DataChem. The type of quality control samples per analysis lot is summarized in Table 4 and followed procedures specified in the USATHAMA QA Manual (December 1985, 2nd Revision, March 1987).

The protocol for analysis of DBP and DPA included the following:

Prior to analysis of any smaples or standards, the instrument was tuned to pass EPA tuning criteria for the calibration standard DFTPP. A representative report received with each data set is given in Attachment C.

A series of standard mixtures containing DPA, DBP and four surrogate compounds (d4 2-chlorophenol [2CLPD4], d4 1,3-dichlorobenzene [13DBD4], d4 diethylphthlate [DEPD4], and d4 di-n-octylphthalate [DNOPD4]) were prepared at concentrations of 150, 37.5, 7.5 and 3.75 ug/L. These were analyzed to prepare a four pont clibration curve. On the day of analysis, one point on this curve was matched (within 25%) using a daily calibration standard.

TABLE 2

QUALITY CONTROL SAMPLES INTERNALLY GENERATED
BY STRAND ASSOCIATES

Analyte*	Quality Control Samples Per Lot
NH3-N	Low Range Duplicate Low Range Spike Standard
COD	Low Range Duplicate Low Range Spike Low Range Standard High Range Duplicate High Range Spike High Range Standard
TKN	Low Range Duplicate Low Range Standard High Range Duplicate High Range Spike High Range Standard
BOD	Duplicate
Total-P	Duplicate Spike Standard
SO4	Duplicate Spike Standard

* Analyte abbreviations are as given in Table 1.
In addition to the above analytes, parameters for which Strand Laboratories provided quality control sample data (i.e. duplicate and blank) were for total dissolved solids, total suspended solids and volatile suspended solids.

TABLE 3

QUALITY CONTROL SAMPLES GENERATED BY ARTHUR D LITTLE
FOR ANALYSIS BY STRAND ASSOCIATES

Analyte*	Quality Control Sample	Number Run 1	Run 2	Total
NH3-N	Field Blank	5	7	12
	Field Duplicate	2	10	12
	Standard	6	7	13
COD	Field Blank	10	13	23
	Field Duplicate	1	12	13
	Standard	10	16	26
	Field Spike	1	16	26
TKN	Field Blank	6	5	11
	Field Duplicate	2	8	10
	Standard	6	5	11
	Field Spike	1	-	1
BOD	Field Blank	6	14	20
	Field Duplicates	2	12	14
	Standard	4	16	20
	Field Spike	1	-	1
Total-P	Field Blank	4	4	8
	Field Duplicate	3	6	9
	Standard	6	4	10
	Field Spike	3	-	3
SO4	Field Blank	1	5	6
	Field Duplicate	2	3	5
	Standard	3	6	9

* Analyte abbreviations are as given in Table 1.

TABLE 4

QUALITY CONTROL SAMPLES GENERATED BY DATACHEM

Analyte*	Quality Control Sample
DPA, DBP	Standard Matrix Method Blank
	Standard Matrix Surrogate Spike (2CLPD4)
	Standard Matrix Surrogate Spike (13DBD4)
	Standard Matrix Surrogate Spike (DEPD4)
	Standard Matrix Surrgoate Spike (DNOPD4)
	Natural Matrix (field samples) Surrogate Spike (2CLPD4)
	Natural Matrix (field samples) Surrogate Spike (13DBD4)
	Natural Matrix (field samples) Surrogate Spike (DEPD4)
	Natural Matrix (filed samples) Surrgoate Spike (DNOPD4)
Nitrate + Nitrite(N)	Standard Matrix Method Blank
	Standard Matrix Low Level Spike
	Standard Matrix High Level Spike (Mean of duplicates)

* Analyte abbreviations are as given in Table 1.

A standard matrix method blank which was extracted concurrently with the sample set was then analyzed to generate the method blank data.

The four surrogate compounds were added to both the standard matrix as well as all of the natural matrices, i.e., all the samples, and recovery data were obtained. Data for the standard matrix (for water and solids) are given in Attachment D and E. Examples of such data for natural matrices are given in Attachment F. Complete data are available upon request.

During the analysis of nitrate plus nitrite (N), the following quality control samples were included:

A method blank, low level spike and duplicate high level spike of the standard matrix were analyzed for each lot of samples. Example of such data is given in Attachment G. Complete data are available on request.

The standard matrix spike recovery and range (precision) for both the semi-volatiles and nitrate plus nitrite (N) analyses were also reported using control charts (Attachment H and I, respectively).

The second type of quality control data monitored were those obtained from samples generated by Arthur D. Little personnel and subsequently sent to DataChem throughout the program as blind samples. The type and number of these quality control samples is summarized in Table 5 while the analytical results are provided in Attachment B.

Badger AAP

Quality control samples for monitoring the performance of ethyl acetate analyses by Badger AAP were prepared by Arthur D. Little. The quality control samples consisted of blind blanks (total of 18), blind standards (total of 25), blind duplicates (total of 26), and a spike. The data obtained from the analysis of these samples is also given in Attachment B.

TABLE 5

QUALITY CONTROL SAMPLES GENERATED BY ARTHUR D LITTLE
FOR ANALYSIS BY DATACHEM

Analyte*	Quality Control Sample	Number Run 1	Run 2	Total
DPA	Field Blank	10	10	20
	Field Duplicate	6	9	15
	Standard	11	8	19
	Field Spike	4	4	8
DPA	Field Blank	10	10	20
	Field Duplicate	6	9	15
	Standard	11	8	19
	Field Spike	4	4	8
NO3+NO2 (N)	Field Blank	4	4	8
	Field Duplicate	7	5	12
	Standard	4	5	9
	Field Spike	1	6	7

* Analyte abbreviations are as given in Table 1.

4.0 Chemical Analysis Results for Quality Control Samples

Strand Associates

The results obtained for the quality control samples sent to Strand Associates are summarized in Tables 6 and 7. These results indicate that analyses of NH3-N, COD, TKN, BOD and SO_4 were in acceptable ranges for the blanks, duplicates, standards and spikes.

DataChem

The results obtained by DataChem for the recovery of surrogates from the Method Blank for Analyses of Water samples (as required by USATHAMA QA Manual for Class IA method using GC/MS) are exemplified in Attachment D. A summary of the dates that lots were analyzed and number of surrogates in the acceptable range is provided in Table 8. The requirement is that at least three of the recoveries be within the control ranges. Explanations for instances where the surrogates were out of the control ranges (given in Attachment D) are provided on each sheet provided in the Attachment. All of the lots were deemed acceptable.

The results obtained by DataChem for the recovery of surrogates from the Method Blank for analyses on solid samples (termed soils in the data) are detailed in Attachment E. A summary of the dates that lots were analyzed, number of acceptable surrogate recoveries (out of a total possible of 4) and acceptability of the analysis is provided in Table 9. The requirement is that at least three of the recoveries be in the control range. Explanations for instances where the surrogates were out of control ranges (given in Attachment E) are provided in the individual sheets provided in the Attachment. All of the lots were deemed acceptable.

Quality control charts incorporating Arthur D. Little, Inc., data were not generated by DataChem. They did, however, evaluate all the

TABLE 6

SUMMARY OF QUALITY CONTROL DATA FOR RUN 1
(ARTHUR D. LITTLE BLIND SAMPLES)*

Analyte	Blanks Range (PPM)	Duplicate (RPD)[a]	Standards (% Recovery)[b]	Spikes (% Recovery)[b]
NH_3-N	<0.02 - 0.05	33.8 ± 4.29	96.7 ± 10	NA[c]
TKN-N	<0.02	8.0 ± 8.8	92.5 ± 11	61.5[d]
COD	<5	11[d]	89.3 ± 5.1	92[d]
Sulfate	<3	11.0 ± 4.2	104 ± 4.1	NA
BOD	<2	15.7 ± 20.2	84.7 ± 15	102[d]
Total P	<0.1 - <0.2	3.8 ± 4.7	99.8 ± 3	106 ± 3.1
DPA	U-0.0043[e]	0.9 ± 1.5	81.8 ± 20	93.8 ± 20.2
DBP	U-0.006	0 ± 0[f]	96.1 ± 17	50.8 ± 32.8
Nitrate plus Nitrite (N)	0.089 - 0.110	3.6 ± 5.0	108 ± 18	108[d]

*Number of data points used in calculations are given in Table 5.
[a]All the data are given in Attachment B.
[b]RPD - Relative Percent Difference
[b]Average and standard deviation
[c]NA - Not applicable
[d]One value
[e]U - Undetected
[f]All samples below detection limits

Arthur D Little

TABLE 7

SUMMARY OF QUALITY CONTROL DATA FOR RUN 2
(ARTHUR D. LITTLE BLIND SAMPLES)*

Analyte	Blanks Range (PPM)	Duplicate (RPD)[a]	Standards (% Recovery)[b]	Spikes (% Recovery)[b]
NH_3-N	<0.02 - 0.05	7.7 ± 6.0	110 ± 12	NA[c]
TKN-N	<0.02	3.9 ± 1.9	92.0 ± 24.2	NA
COD	<5	4.2 ± 4.1	93.4 ± 16.1	NA
Sulfate	<3	4.9 ± 8.3	103 ± 53	NA
BOD	<2	5.4 ± 6.3	87.1 ± 8.7	NA
Total P	<0.1	8.3 ± 15.9	90.5 ± 22.0	NA
DPA	U-0.0018[e]	7.8 ± 7.5	74.8 ± 10.6	71.0 ± 42.9
DBP	U-0.0027	14.2 ± 14.6	85.6 ± 30.4	72.7 ± 31.1
Nitrate plus Nitrite (N)	0.030 - 0.290	5.8 ± 9.6	113 ± 12	126 ± 17
EA	<5-25	5.4 ± 8.4	101 ± 8	103[d]

*Number of data points used in calculations are given in Table 5.
All the data are given in Attachment B.
[a]RPD - Relative Percent Difference
[b]Average and standard deviation
[c]NA - Not applicable
[d]One value
[e]U - Undetected.

Arthur D Little

TABLE 8

RECOVERY OF SURROGATES FROM METHOD BLANKS
IN DPA, DBP ANALYSIS IN WATER SAMPLES
DATECHEM

Date First Analyzed	Number of Surrogates in Acceptable Range*	Explanation** Provided	Acceptable
10-7-87	4	-	Yes
10-15-87	4	-	Yes
10-21-87	4	-	Yes
10-24-87	3	Yes	Yes
10-29-87	4	-	Yes
11-2-87	4	-	Yes
11-5-87	4	-	Yes
11-11-87	4	-	Yes
11-12-87	4	-	Yes
11-18-87	2	Yes	Yes
11-19-87	2	Yes	yes
11-24-87	3	Yes	Yes
12-3-87	4	-	Yes
12-8-87	4	-	Yes
12-9-87	4	-	Yes
12-10-87	4	-	Yes
12-14-87	3	Yes	Yes
12-21-87	4	-	Yes
12-22-87	4	-	Yes
1-11-88	4	-	Yes
1-12-88	4	-	Yes
1-18-88	4	-	Yes
1-19-88	4	-	Yes
1-26-88	4	-	Yes
2-1-88	4	-	Yes
2-5-88	4	-	Yes
2-9-88	4	-	Yes
2-23-88	4	-	Yes
3-2-88 (lot 1)	4	-	Yes
3-2-88 (lot 2)	4	-	Yes
3-3-88	4	-	Yes
3-4-88	4	-	Yes
3-15-88	4	-	Yes
3-17-88 (lot 1)	4	-	Yes
3-17-88 (lot 2)	4	-	Yes
3-23-88 (lot 1)	2	Yes	Yes
3-23-88 (lot 2)	3	Yes	Yes
3-29-88	4	-	Yes
3-30-88 (lot 1)	4	-	Yes
3-30-88 (lot 2)	4	-	Yes
4-6-88	4	-	Yes
4-13-88	3	Yes	Yes
4-14-88	4	-	Yes
4-19-88	4	-	Yes
4-25-88	3	Yes	Yes
4-26-88	3	Yes	Yes

* Maximum is four. See text.
** See notes given in Attachment D.

TABLE 9

RECOVERY OF SURROGATES FROM METHOD BLANKS
IN DPA, DBP ANALYSIS IN SOLID SAMPLES
DATACHEM

Date First Analyzed	Number of Surrogates in Acceptable Range*	Explanation** Provided	Acceptable
10-26-87	4	-	Yes
11-3-87	4	-	Yes
11-11-87	4	-	Yes
11-18-87	3	Yes	Yes
11-24-88	4	-	Yes
12-10-87	1	Yes	Yes
12-21-87	4	-	Yes
12-22-87	4	-	Yes
1-19-88	3	Yes	Yes
2-1-88	3	Yes	Yes
2-26-88	2	Yes	Yes
3-17-88	4	-	Yes
3-28-88	4	-	Yes
4-1-88	4	-	Yes
4-13-88	2	Yes	Yes
4-14-88	4	-	Yes
4-26-88	3	Yes	Yes
12-8-88	4	-	Yes

*Maximum is four.
** See notes given in Attachment E.

surrogate recoveries and range data by the same criteria as USATHAMA data points to ensure they were in control (see Attachment H).

Data were also obtained for recoveries of the four surrogates from each of the samples. An example of this data is provided in Attachment E. Complete data are available upon request. Since no criteria for acceptance is available from the USATHAMA QA manual for recoveries from samples, the QA Acceptance Criteria provided in SW846 (September 1986, pp. 8270-24 and -25) were used to assess the data. These criteria are summarized in Table 10. Three out of the four recoveries were greater than the upper limits by a few percent. None of the surrogate recoveries appeared to be out of line with the requirements of the program. The data is deemed acceptable.

In all cases (except one), the standard matrix method blank gave a U (undetectable) for concentrations of DPA and DBP. (In the single exception, the concentration of DBP was 0.07 ug/L well below the estimated method detection limit).

In the analysis of total nitrate plus nitrite (N) data for low level spike and duplicate high level spike were obtained. Example representative data are shown in Attachment G (complete data are available upon request). All the recoveries are within acceptable ranges. Quality control charts for recoveries and range (precision) were not generated by DataChem which included the Arthur D. Little data. DataChem did, however, evaluate each of the points by the same criteria as USATHAMA data points to ensure that they were in control (Attachment H).

The results of quality control samples generated by Arthur D. Little for DPA, DBP and nitrate plus nitrite analyses by DataChem are summarized in Tables 6 and 7. The data for blanks, blind standards, blind duplicates and blind spikes are reasonable for all analytes. It should be noted that QC Acceptance Criteria for di-n-butylphthalate recoveries are in the range of 1 to 118 percent. It should be noted that the low spike recovery (although still well within this QC

TABLE 10

QC ACCEPTANCE CRITERIA FROM SW-846 FOR RECOVERIES OF COMPOUNDS

Compound	Percent Recovery Range
Surrogates:	
2-Chlorophenol	23-134
1,3-Dichlorobenzene	D-172
Diethylphthalate	D-114
Di-n-octylphthalte	4-146

Source: EPA SW-846 (September, 1986) pp. 8270-24 to 8270-25

D = Dtection Limit

acceptance range) observed in some samples for DBP were noted for samples spiked prior to shipment of the samples for analysis. However, on-site spiking of similar samples may be associated with the transport time and the concurrent biological activity in the samples resulting in loss of the spiked analyte and not the chemical analysis procedure.

Badger AAP

The results of quality control samples generated by Arthur D. Little to monitor analysis of ethyl acetate by the Badger AAP Laboratory are summarized in Table 7. These data indicate that the blanks, blind standards, blind duplicates and spike were all reasonable.

5.0 Audits

A visit was made on (December 9, 1987) by the Arthur D. Little Quality Control representative to the Badger AAP/Arthur D. Little pilot-test facility. The Checklist for Laboratory Adherence (only as it pertains to sampling) was utilized as a guide. This visit indicated the need for corrective actions in documentation and frequency of insertion of blind QC samples to the analysis laboratories. Although these deficiencies were identified, they are not expected to impact the final assessment on the quality of data generated by the analysis laboratories. The deficiencies were discussed and corrected for subsequent pilot-test runs.

The Quality Control representative then visited the Badger AAP Laboratories on December 10, 1987. During that visit, past and future Quality Control practices were discussed. Revised procedures and practices were determined for all future work. These discussions led to an indication that the procedures previously used were not sufficient to ensure quality ethyl acetate data. Severe qualification of this data or the not reporting of it was suggested. Consequently, it was decided that none of this data would be used in this report. Quality control samples generated by Arthur D. Little for subsequent pilot testing indicated that the data generated were acceptable.

A visit to Strand Associates was also made by the Arthur D. Little Quality Control representative on December 10, 1987. During this visit, the Checklist for Laboratory Adherence (Appendix M, USATHAMA QA Manual, December 1985 [Second edition, March 1987]) forms were used. In addition, a backward tracing of data for five analytes (for randomly chosen samples) was made. The laboratory facilities and practices were found to be acceptable.

ATTACHMENT A

REPRESENTATIVE LISTING OF QC DATA OBTAINED
FROM STRAND ASSOCIATES

Lab Client: Arthur D. Little

Sample # 6235-6239

QUALITY CONTROL

Ammonia Nitrogen

Sample #6219 - L.R. Duplicate difference = 0.06
L.R. Spike 1.0 mg/L = 105% recovery
Standard 1.5 mg/L = 98% recovery

Chemical Oxygen Demand

Sample #6267 - L.R. Duplicate difference = 2
L.R. Spike 50 mg/L = 94% recovery
Standard 50 mg/L = 109% recovery

Sample #6263 - H.R. Duplicate difference = 10
H.R. Spike 750 mg/L = 104% recovery
Standard 750 mg/L = 95% recovery

Total Kjeldahl Nitrogen

Sample #6267 - L.R. Duplicate difference = 0.48
Standard 1.5 mg/L = 93% recovery

Sample #6263 - H.R. Duplicate difference = 0.2
H.R. Spike 30 mg/L = 94% recovery
Standard 45 mg/L = 92% recovery

Biochemical Oxygen Demand

Sample #6235 - Duplicate difference = 6

Sulfate

Sample #6239 - Duplicate difference = 7
Spike 20 mg/L = 104%
Standard 20 mg/L = 102% recovery

Total Dissolved Solids

Sample #6235 - Duplicate difference = 16
Blank = 0.0003 gram

Total Suspended Solids

Sample #6235 - Duplicate difference = 0
Blank = 0.0001 gram

M.L. Volatile Suspended Solids

Sample #6236 - Duplicate difference = 120
Blank = 0.0003 gram

Arthur D Little

ATTACHMENT B

RESULTS OF QC SAMPLES GENERATED
BY ARTHUR D. LITTLE

Arthur D Little

TABLE QC 1-1

QUALITY CONTROL MONITORING DATA FOR STRAND - NH3
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	-DUPLICATES Relative Difference (%)
BLANK	120B	0.05			
	121B	<0.02			
	695B	<0.02			
	696B	<0.02			
	750B	<0.02			
STANDARD	680B	4.46	4.3	103.7	
	681B	4.42	4.3	102.8	
	682B	4.22	4.3	98.1	
	691B	4.06	4.3	94.4	
	692B	3.37	4.3	78.4	
	753B	4.42	4.3	102.8	
			Average:	96.7	
			SD:	10	
DUPLICATE	665B (1)	19.5			
	693B (2)	25.5			30.8
	670B (1)	0.76			
	694B (2)	1.04			36.8
				AVERAGE:	33.8
				SD:	4.29

TABLE QC 1-2

QUALITY CONTROL MONITORING DATA FOR STRAND - TKN
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	STANDARDS Reference Level (ppm)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	118B	<0.02			
	119B	<0.02			
	121B	<0.02			
	695B	<0.02			
	696B	<0.02			
	750B	<0.02			
STANDARD	676B	2.86	3.3	86.7	
	678B	2.85	3.3	86.4	
	679B	2.81	3.3	85.2	
	689B	3.00	3.3	90.9	
	690B	3.00	3.3	90.9	
	752B	3.80	3.3	115.0	
			Average:	92.5	
			SD:	11	
DUPLICATE	666B (1)	54.1			
	693B (2)	61.8			14.2
	670B (1)	5.5			
	694B (2)	5.6			1.8
				AVERAGE:	8.0
				SD:	8.78
SPIKE	754B	5.84	7.1	61.5	

(Spike of 748B with 3.3ppm)

TABLE QC 1-3

QUALITY CONTROL MONITORING DATA FOR STRAND - COD
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	118B	<5			
	119B	<5			
	121B	<5			
	413B	<5			
	414B	<5			
	483B	<5			
	600B	<5			
	695B	<5			
	696B	<5			
	750B	<5			
STANDARD	409B	67	73.0	91.8	
	410B	61	73.0	83.6	
	411B	31	36.5	84.9	
	412B	36	36.5	98.6	
	481B	67	73.0	91.8	
	482B	35	36.5	95.9	
	601B	62	73.0	84.9	
	689B	64	73.0	87.7	
	690B	62	73.0	84.9	
	752B	65	73.0	89.0	
			Average:	89.3	
			SD:	5.12	
DUPLICATE	670B (1)	38			
	694B (2)	42			11
SPIKE	754B	99	105	92	
	(Spike of 748B with 73ppm)				

TABLE QC 1-4

QUALITY CONTROL MONITORING DATA FOR STRAND - SULFATE
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	779B	<3			
STANDARD	683B	142	136	104	
	684B	146	136	107	
	781B	135	136	99.3	
			Average:	104	
			SD:	4.09	
DUPLICATE	665B (1)	2200			
	685B (2)	1900			14
	775B (1)	2600			
	780B (2)	2400			8
				Average:	11.0
				SD:	4.24

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TABLE QC 1-5

QUALITY CONTROL MONITORING DATA FOR STRAND - BOD
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	116B	<2			
	407B	<2			
	408B	<2			
	480B	<2			
	598B	<2			
	749B	<2			
STANDARD	478B	41	44	93.2	
	479B	19	22	86.4	
	599B	28	44	63.6	
	751B	42	44	95.5	
			Average:	84.7	
			SD:	15	
DUPLICATE	665B	730			
	685B	720			1.4
	737B	10			
	746B	7			30.0
				Average:	15.7
				SD:	20.22
SPIKE	755B	52		102.3	

(Spike of 746B with 44ppm)

TABLE QC 1-6

QUALITY CONTROL MONITORING DATA FOR STRAND - TOT P
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	STANDARDS Reference Level (ppm)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	118B	<0.2			
	119B	<0.2			
	121B	<0.2			
	750B	<0.1			
STANDARD	689B	4.25	4.2	101	
	690B	4.38	4.2	104	
	676B	4.09	4.2	97.4	
	678B	4.08	4.2	97.1	
	679B	4.11	4.2	97.9	
	752B	4.25	4.2	101	
			Average:	99.8	
			SD:	3	
DUPLICATE	666B (1)	9.16			
	693B (2)	9.38			2.4
	670B (1)	6.16			
	694B (2)	5.60			9.1
	695B (1)	<0.1			
	696B (2)	<0.1			0.0
				Average:	3.8
				SD:	4.72
SPIKE	697B (Spike of 666B with 4.2ppm)	13.5		103.3	
	698B (Spike of 670B with 4.2ppm)	10.6		105.7	
	754B (Spike of 748B with 4.2ppm)	10.3		109.5	
			Average:	106.2	
			SD:	3.12	

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TABLE QC 1-7

QUALITY CONTROL MONITORING DATA FOR UBTL - DPA
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	STANDARDS Reference Level (ppb)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	146B	2.9			
	147B	3.1			
	148B	2.8			
	149B	2.9			
	525B	U			
	559B	4.3			
	560B	4.1			
	587B	1.2J			
	651B	3.7			
	784B	U			
STANDARD	617B	440	500	88.0	
	618B	410	500	82.0	
	652B	420	500	84.0	
	699B	110	100	110	
	700B	99	100	99.0	
	701B	96	100	96.0	
	702B	150	200	75.0	
	703B	150	200	75.0	
	704B	190	200	95.0	
	708B	110	200	55.0	
	785B	81.0	200	40.5	
			Average:	81.8	
			SD:	20	
DUPLICATE	433B (1)	55			
	434B (2)	57			3.5
	433B (1)	55			
	435B (2)	58			1.7
	523B (1)	U			
	524B (2)	U			0.0
	585B (1)	1.0J			
	586B (2)	U			0.0
	662B (1)	U			
	663B (2)	U			0.0
	763B (1)	U			
	764B (2)	U			0.0
				Average:	0.9
				SD:	1.46

TABLE QC 1-7 (continued)

QUALITY CONTROL MONITORING DATA FOR UBTL - DPA
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	STANDARDS Reference Level (ppb)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
SPIKE	706B	190	200	95.0	
	(Spike of 672B with 200ppb)				
	707B	210	200	105.0	
	(Spike of 672B with 200ppb)				
	765B	220.0	200	110.0	
	(Spike of 673B with 200ppb at UBTL)				
	766B	130.0	200	65.0	
	(Spike of 673B with 200ppb)				
			Average:	93.8	
			SD:	20.16	

TABLE QC 1-8

QUALITY CONTROL MONITORING DATA FOR UBTL - DBP
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	STANDARDS Reference Level (ppb)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	148B	3.6			
	149B	3.5			
	525B	U			
	560B	2.3J			
	587B	3.2			
	618B	U			
	651B	U			
	652B	1.2J			
	699B	U			
	700B	U			
	701B	4.3			
	702B	5			
	703B	5.2			
	704B	6			
	784B	U			
STANDARD	141B	19.3	20	96.3	
	142B	17.4	20	86.9	
	147B	24.1	20	121	
	144B	110.0	100	110	
	145B	111.6	100	112	
	146B	99.6	100	99.6	
	559B	130	200	65.0	
	617B	530	500	106	
	708B	150	200	75.0	
	785B	180.0	200	90.0	
			Average:	96.1	
			SD:	17	
DUPLICATE	433B (1)	1.3J			
	434B (2)	1.0J			0.0
	523B (1)	U			
	524B (2)	U			0.0
	585B (1)	U			
	586B (2)	U			0.0
	662B (1)	U			
	663B (2)	U			0.0
	763B (1)	U			
	764B (2)	U			0.0

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TABLE QC 1-8 (continued)

QUALITY CONTROL MONITORING DATA FOR UBTL - DBP
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	STANDARDS Reference Level (ppb)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
SPIKE	435B	15	200	7.5	
	(Spike of 434B with 200ppb)				
	705B	26	200	12.5	
	(Spike of 761B with 200ppb)				
	706B	150	200	75.0	
	(Spike of 672B with 200ppb)				
	707B	120	200	60.0	
	(Spike of 672B with 200ppb)				
	765B	170	200	85.0	
	(Spike of 673B with 200ppb at UBTL)				
	766B	130	200	65.0	
	(Spike of 673B with 200ppb)				
			Average:	50.8	
			SD:	32.81	

TABLE QC 1-9

QUALITY CONTROL MONITORING DATA FOR UBTL - NO3
(Run 1)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	-----STANDARDS------- Reference Level (ppb)	Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	163B	97			
	164B	89			
	165B	110			
	711B	80			
STANDARD	436B	6500	6500	100	
	437B	6300	6500	96.9	
	438B	7100	6500	109	
	439B	3200	3250	98.5	
	440B	3500	3250	108	
	441B	4800	3250	148	
	790B	6300	6500	96.9	
			Average:	108	
			SD:	18	
DUPLICATE	675B (1)	56000			
	712B (2)	52000			7.1
	787B (1)	46000			
	788B (2)	46000			0.0
				Average:	3.6
				SD:	5.02
SPIKE	789B	53000	52500	107.7	

(Spike of 787B with 6500 ppb)

TABLE QC 2-1

QUALITY CONTROL MONITORING DATA FOR STRAND - NH3
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	-DUPLICATES Relative Difference (%)
BLANK	206D	<0.02			
	400D	<0.02			
	602D	<0.02			
	829D	0.05			
	1096D	<0.02			
	1143D	<0.02			
	1327D	<0.04			
STANDARD	207D	4.2	4.1	102.4	
	401D	4.88	4.1	119.0	
	603D	3.98	4.1	97.1	
	830D	4.42	4.1	107.8	
	1098D	4.3	4.1	104.9	
	1142D	4.24	4.1	103.4	
	1326D	5.44	4.1	132.7	
			Average:	109.6	
			SD:	12.20	
DUPLICATE	200D (1)	30.9			
	201D (2)	28.9			6.9
	215D (1)	3.7			
	216D (2)	3.9			5.1
	281D (1)	36.6			
	282D (2)	39.4			7.1
	338D (1)	61.8			
	344D (2)	63.9			3.3
	394D (1)	81.8			
	399D (2)	79.2			3.3
	409D (1)	66.3			
	415D (2)	64.1			3.4
	596D (1)	26.4			
	601D (2)	25.9			1.9
	1085D (1)	8.8			
	1097D (2)	7.6			15.8
	1133D (1)	4.8			
	1140D (2)	6.2			22.6
	1318D (1)	1.42			
	1325D (2)	1.54			7.8
				Average:	7.7
				SD:	6.55

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TABLE QC 2-2

QUALITY CONTROL MONITORING DATA FOR STRAND - TKN
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	STANDARDS Reference Level (ppm)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	206D	<0.2			
	400D	<0.2			
	602D	<0.2			
	829D	<0.2			
	1143D	<0.2			
STANDARD	208D	2.42	2.3	105.2	
	401D	3.3	5.1	64.7	
	830D	6.05	5.1	118.6	
	1141D	4.24	4.1	103.4	
	1267D	2.24	3.3	67.9	
			Average:	92.0	
			SD:	24.19	
DUPLICATE	200D (1)	70.6			
	201D (2)	68.2			3.5
	215D (1)	59.6			
	216D (2)	56.5			5.5
	281D (1)	49.4			
	282D (2)	52.8			6.4
	338D (1)	73.6			
	344D (2)	72.8			1.1
	394D (1)	81.8			
	399D (2)	79.2			3.3
	409D (1)	95.8			
	415D (2)	91.4			4.8
	596D (1)	65.2			
	601D (2)	64.1			1.7
	1133D (1)	54.2			
	1140D (2)	51.6			5.0
				Average:	3.9
				SD:	1.86

TABLE QC 2-3

QUALITY CONTROL MONITORING DATA FOR STRAND - COD
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	1480	<5			
	2830	<5			
	3480	<5			
	4170	<5			
	4810	<5			
	5520	<5			
	6200	<5			
	6910	<5			
	7650	<5			
	8480	<5			
	9350	<5			
	10350	<5			
	11900	<5			
STANDARD	1500	59	54	109.3	
	2250	47	54	87.0	
	2240	54	54	100.0	
	2840	51	54	94.4	
	3460	44	54	81.5	
	4190	48	54	88.9	
	4850	42	54	77.8	
	5500	43	54	79.6	
	6220	49	54	90.7	
	6930	47	54	87.0	
	7650	46	54	85.2	
	8500	49	54	90.7	
	9390	79	54	146.3	
	10360	50	54	92.6	
	11160	51	54	94.4	
	12670	48	54	88.9	
			Average:	93.4	
			SD:	16.07	

TABLE QC 2-3 (continued)

QUALITY CONTROL MONITORING DATA FOR STRAND - COD
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
DUPLICATE	153D (1)	1385			
	154D (2)	1340			3.4
	200D (1)	1210			
	201D (2)	1225			1.2
	215D (1)	1444			
	216D (2)	1425			1.3
	281D (1)	1020			
	282D (2)	1040			1.9
	338D (1)	908			
	344D (2)	892			1.8
	409D (1)	1260			
	415D (2)	1375			8.4
	475D (1)	1195			
	483D (2)	1133			5.5
	683D (1)	1215			
	689D (2)	1225			0.8
	756D (1)	1100			
	757D (2)	1124			2.1
	1020D (1)	980			
	1034D (2)	864			13.4
	1178D (1)	1040			
	1186D (2)	950			9.5
	1255D (1)	780			
	1263D (2)	770			1.3
				Average:	4.2
				SD:	4.10

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TABLE QC 2-4

QUALITY CONTROL MONITORING DATA FOR STRAND - SULFATE
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	STANDARDS Reference Level (ppm)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	183D	<3			
	373D	<3			
	576D	<3			
	793D	<3			
	1063D	<3			
STANDARD	181D	146	136	107.4	
	373D	142	136	104.4	
	577D	132	136	97.1	
			Average:	102.9	
			SD:	5.30	
DUPLICATE	173D (1)	2200			
	182D (2)	2120		3.8	
	366D (1)	2270			
	372D (2)	2300		1.3	
	569D (1)	2100			
	575D (2)	2100		0.0	
	790D(1)	2040			
	792D(2)	2100		2.9	
	790D(1)	2040			
	794D(2)	2600		21.5	
	1055D (1)	2500			
	1064D (2)	2500		0.0	
			Average:	4.9	
			SD:	8.28	

TABLE QC 2-5

QUALITY CONTROL MONITORING DATA FOR STRAND - BOD
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	147D	<2			
	279D	<2			
	347D	<2			
	416D	<2			
	480D	<2			
	551D	<2			
	619D	<2			
	690D	<2			
	764D	<2			
	847D	<2			
	934D	<2			
	1032D	<2			
	1189D	<2			
	1264D	<2			
STANDARD	149D	23	32	71.9	
	225D	24	32	75.0	
	223D	24	32	75.0	
	280D	28	32	87.5	
	345D	34	32	106.3	
	418D	26	32	81.3	
	484D	29	32	90.6	
	549D	30	32	93.8	
	621D	29	32	90.6	
	692D	27	32	84.4	
	766D	29	32	90.6	
	849D	30	32	93.8	
	938D	29	32	90.6	
	1032D	29	32	90.6	
	1119D	26	32	81.3	
	1187D	29	32	90.6	
			Average:	87.1	
			SD:	8.68	

TABLE QC 2-5 (continued)

QUALITY CONTROL MONITORING DATA FOR STRAND - BOD
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
DUPLICATE	151D (1)	650			
	152D (2)	590			10.2
	213D (1)	910			
	214D (2)	880			3.4
	277D (1)	740			
	278D (2)	730			1.4
	337D (1)	680			
	343D (2)	650			4.6
	474D (1)	750			
	482D (2)	760			1.3
	611D (1)	880			
	617D (2)	865			1.7
	682D (1)	900			
	688D (2)	850			5.9
	922D (1)	770			
	936D (2)	765			0.7
	1019D (1)	690			
	1031D (2)	720			4.2
	1102D (1)	760			
	1118D (2)	620			22.6
	1177D (1)	638			
	1185D (2)	640			0.3
	1254D (1)	400			
	1262D (2)	440			9.1
				Average:	5.4
				SD:	6.28

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TABLE QC 2-6

QUALITY CONTROL MONITORING DATA FOR STRAND - TOT P
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	STANDARDS Reference Level (ppm)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	206D	<0.1			
	400D	<0.1			
	602D	<0.1			
	1143D	<0.1			
STANDARD	208D	4.91	4.9	100.2	
	401D	2.42	4.2	57.6	
	1141D	4.91	4.9	100.2	
	1267D	5.09	4.9	103.9	
			Average:	90.5	
			SD:	21.97	
DUPLICATE	215D (1)	6.75			
	216D (2)	6.88			1.9
	281D (1)	5.0			
	282D (2)	4.79			4.4
	338D (1)	3.50			
	344D (2)	3.58			2.2
	409D (1)	5.9			
	415D (2)	4.2			40.5
	756D (1)	3.68			
	757D (2)	3.66			0.5
	1133D (1)	0.8			
	1140D (2)	0.8			0.0
				Average:	8.3
				SD:	15.87

TABLE QC 2-7

QUALITY CONTROL MONITORING DATA FOR UBTL - DPA
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	STANDARDS Reference Level (ppb)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	113D	U			
	261D	U			
	385D	1.8J			
	456D	U			
	524D	U			
	658D	U			
	813D	U			
	999D	U			
	1238D	U			
	1313D	U			
STANDARD	132D	360	500	72.0	
	260D	300	500	60.0	
	386D	440	500	88.0	
	457D	330	500	66.0	
	525D	440	500	88.0	
	659D	420	500	84.0	
	814D	350	500	70.0	
	1000D	350	500	70.0	
			Average:	74.8	
			SD:	10.58	
DUPLICATE	130D (1)	1300			
	131D (2)	1300			0.0
	234D (1)	11			
	235D (2)	9.9			11.1
	359D (1)	1900			
	360D (2)	2000			5.0
	454D (1)	1600			
	459D (2)	1600			0.0
	498D (1)	1500			
	500D (2)	1300			15.4
	634D (1)	U			
	637D (2)	U			0.0
	962D (1)	1800			
	964D (2)	1600			12.5
	1235D (1)	350			
	1237D (2)	440			20.5
	1310D (1)	750			
	1311D (2)	710			5.6
				Average:	7.8
				SD:	7.47

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TABLE QC 2-7 (continued)

QUALITY CONTROL MONITORING DATA FOR UBTL - DPA
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	-----STANDARDS------- Reference Level (ppb)	Recovery (%)	DUPLICATES Relative Difference (%)
SPIKE	236D	290	500	55.8	
	(SPIKE OF 234D [11PPB] WITH 500 PPB)				
	361D	2500	500	120.0	
	(SPIKE OF 359D [1900 PPB] WITH 500 PPB)				
	638D	440.0	500	88.0	
			Average:	71.0	
			SD:	42.9	

TABLE QC 2-8

QUALITY CONTROL MONITORING DATA FOR UBTL - DBP
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	STANDARDS Reference Level (ppb)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	113D	U			
	261D	U			
	385D	U			
	456D	U			
	524D	2.7			
	658D	2J			
	813D	U			
	999D	U			
	1238D	U			
	1313D	U			
STANDARD	132D	130	200	65.0	
	260D	310	500	62.0	
	336D	430	500	86.0	
	457D	320	500	64.0	
	525D	740	500	148.0	
	659D	530	500	106.0	
	814D	470	500	94.0	
	1300D	300	500	60.0	
			Average:	85.6	
			SD:	30.43	
DUPLICATE	130D (1)	82			
	131D (2)	93			11.8
	234D (1)	U			
	235D (2)	U			0.0
	359D (1)	920			
	360D (2)	900			2.2
	454D (1)	900			
	459D (2)	1100			18.2
	498D (1)	810			
	500D (2)	620			30.6
	634D (1)	1.1J			
	637D (2)	U			0.0
	962D (1)	1700			
	964D (2)	1200			41.7
	1235D (1)	180			
	1237D (2)	220			18.2
	1310D (1)	880			
	1311D (2)	840			4.8
				Average:	14.2
				SD:	14.57

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TABLE QC 2-8

QUALITY CONTROL MONITORING DATA FOR UBTL - DBP
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	STANDARDS Reference Level (ppb)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
SPIKE	2360	79	500	15.8	reaction
	(SPIKE OF 2340 [U PPB] WITH 500 PPB)				
	3610	1300	500	76.0	
	(SPIKE OF 3590 [920 PPB] WITH 500 PPB)				
	6380	510.0	500	102.0	
	(SPIKE OF 6340 [1.1J] WITH 500 PPB)				
	9650	1400.0	500	40.0	
	(SPIKE OF 9620 [1200 PPB] WITH 500 PPB)				
			Average:	72.7	
			SD:	31.13	

TABLE QC 2-9

QUALITY CONTROL MONITORING DATA FOR UBTL - NO3
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppb)	STANDARDS Reference Level (ppb)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	664D	110			
	902D	290			
	983D	130			
	1222D	30			
STANDARD	262D	4300	3500	123	
	665D	3500	3500	100	
	903D	4300	3500	123	
	1223D	3700	3500	106	
			Average:	112.9	
			SD:	11.78	
DUPLICATE	256D (1)	680			
	263D (2)	680			0.00
	661D (1)	9700			
	662D (2)	9400			3.19
	898D (1)	1400			
	900D (2)	1400			0.00
	1218D (1)	40			
	1221D (2)	50			20
				Average:	5.8
				SD:	9.59
SPIKE	264D	4600	3500	131.4	
	(SPIKE OF 256D [680 PPB] WITH 3500 PPB)				
	901D	5200	3500	148.6	
	(SPIKE OF 898D [1400 PPB] WITH 3500 PPB)				
	986D	4000	3500	114.3	
	(SPIKE OF 981D [1200 PPB] WITH 3500 PPB)				
	1224D	3900	3500	111.4	
	(SPIKE OF 1218D [40 PPB] WITH 3500 PPB)				
			Average:	126.4	
			SD:	17.20	

TABLE QC 2-10

QUALITY CONTROL MONITORING DATA FOR BAAP - EA
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
BLANK	107D	<10			
	145D	<10			
	172D	<10			
	212D	<5			
	292D	<10			
	336D	23			
	407D	23			
	473D	10			
	540D	24			
	610D	22			
	669D	25			
	773D	14			
	836D	14			
	921D	16			
	1018D	18			
	1101D	15			
	1176D	14			
	1253D	8			

TABLE QC 2-10 (continued)

QUALITY CONTROL MONITORING DATA FOR BAAP - EA
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	STANDARDS Reference Level (ppm)	STANDARDS Recovery (%)	DUPLICATES Relative Difference (%)
STANDARD					
	185D	93	100	93.0	
	238D	855	900	95.0	
	266D	892	900	99.1	
	294D	845	900	93.9	
	314D	455	400	113.8	
	352D	440	450	97.8	
	365D	429	450	95.3	
	392D	340	450	75.6	
	425D	420	450	93.3	
	447D	422	450	93.8	
	491D	452	450	100.4	
	515D	411	450	91.3	
	558D	395	450	87.8	
	583D	400	450	88.9	
	636D	371	360	103.1	
	668D	536	540	99.3	
	681D	354	360	98.3	
	709D	376	360	104.4	
	738D	431	460	93.7	
	775D	466	450	103.6	
	804D	477	450	106.0	
	869D	477	450	106.0	
	907D	478	450	106.2	
	967D	482	450	107.1	
	1042D	460	450	102.2	
	1070D	446	450	99.1	
	1121D	464	450	103.1	
	1149D	458	450	101.8	
	1196D	361	450	80.2	
	1226D	452	450	100.4	
	1273D	462	450	102.7	
			Average:	101.2	
			SD:	7.9	

TABLE QC 2-10 (continued)

QUALITY CONTROL MONITORING DATA FOR BAAP - EA
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
DUPLICATE	124D (1)	499			
	125D (2)	458			9.0
	169D (1)	165			
	170D (2)	163			1.2
	197D (1)	299			
	198D (2)	335			10.7
	247D (1)	410			
	248D (2)	432			5.1
	303D (1)	252			
	304D (2)	268			6.0
	325D (1)	123			
	326D (2)	123			0.0
	434D (1)	273			
	435D (2)	290			5.9
	460D (1)	153			
	461D (2)	145			5.5
	502D (1)	45			
	503D (2)	75			40.0
	527D (1)	65			
	528D (2)	72			9.7
	567D (1)	356			
	568D (2)	355			0.3
	593D (1)	222			
	594D (2)	210			5.7
	647D (1)	386			
	648D (2)	401			3.7
	724D (1)	391			
	725D (2)	391			0.0
	752D (1)	244			
	753D (2)	256			4.7
	855D (1)	395			
	856D (2)	392			0.8
	893D (1)	276			
	891D (2)	265			2.3
	987D (1)	259			
	988D (2)	260			0.4
	1037D (1)	400			
	1038D (2)	403			0.7
	1039D (1)	1014			
	1040D (2)	1072			5.4
	1053D (1)	816			
	1054D (2)	794			2.8
	1082D (1)	210			
	1083D (2)	210			0.0

TABLE QC 2-10 (continued)

QUALITY CONTROL MONITORING DATA FOR BAAP - EA
(Run 2)

SAMPLE TYPE	SAMPLE CODE	ANALYZED LEVEL (ppm)	-----STANDARDS------- Reference Level (ppm)	Recovery (%)	DUPLICATES Relative Difference (%)
DUPLICATE	1130D (1)	244			
(continued)	1131D (2)	200			22.0
	1161D (1)	184			
	1162D (2)	182			1.1
	1207D (1)	305			
	1208D (2)	302			1.0
	1240D (1)	588			
	1241D (2)	585			0.5
	1284D (1)	282			
	1285D (2)	277			1.8
				Average:	5.4
				SD:	8.4
SPIKE	678D	548	360	103.1	
	(Spike of 677D [177 ppm] with 360 ppm)				

Arthur D Little

ATTACHMENT C

REPRESENTATIVE GC/MS TUNING DATA FROM DATACHEM

METHOD PERFORMANCE (DFTPP)

Before any samples are analyzed the mass spectrometer is tuned such that the EPA performance criteria for DFTPP are achieved. The documentation for tuning compliance has been included with this report on the following page(s). The entry for % relative abundance in the top right hand column is the actual results obtained with 50 ng DFTPP. The results are listed opposite the method criteria for each ion. The samples analyzed appear on the lower half of the report with the date and time of analysis.

Jerry Lambert
4/14/88

GC/MS TUNING AND MASS CALIBRATION
Decafluorotriphenylphosphine (DFTPP)

Contractor DATACHEM

Instrument ID MS-8 Date 04/14/88 Time 09:55:00

Lab ID IV1DFTPP Data Release Authorized By:

m/e	ION ABUNDANCE CRITERIA	%RELATIVE ABUNDANCE	
51	30.0 - 60.0% of mass 198	52.95	
68	less than 2.0% of mass 69	1.07	(1.98) 1
69	mass 69 relative abundance	54.56	
70	less than 2.0% of mass 69	0.00	(0.00) 1
127	40.0 - 60.0% of mass 198	40.39	
197	less than 1.0% of mass 198	0.00	
198	base peak, 100% relative abundance	100.00	
199	5.0 - 9.0% of mass 198	6.35	
275	10.0 - 30.0% of mass 198	16.95	
365	greater than 1.0% of mass 198	1.14	
441	present, but less than mass 443	6.10	
442	greater than 40.0% of mass 198	41.09	
443	17.0 - 23.0% of mass 442	8.24	(20.08) 2

1 Value in parenthesis is % mass 69
2 Value in parenthesis is % mass 442

THIS PERFORMANCE TUNE APPLIES TO THE FOLLOWING SAMPLES, BLANKS, AND STANDARDS.

SAMPLE ID	LAB ID	DATE OF ANALYSIS	TIME OF ANALYSIS
DAILY STD 150	IU5ADL150	04/14/88	12:57:00
DAILY STD 37.5	IV7ADL37	04/14/88	14:18:00
QCMB - H2O	IV10ADLQCW	04/14/88	15:53:00
EH1027	IV11EH1027	04/14/88	16:25:00
EH1029	IV12EH1029	04/14/88	16:56:00
QCMB - SOIL	IV16ADLQCS	04/14/88	17:29:00
EH1030- FILTRATE	IV13EH1030	04/14/88	17:59:00
EH1030- SOLID	- IV17EH1030	04/14/88	18:31:00
EH1026-1 IN 20 DIL	IV14EH1026	04/14/88	19:01:00
EH1028-1 IN 20 DIL	IV15EH1028	04/14/88	19:33:00

ATTACHMENT D

SURROGATE RECOVERIES (STANDARD MATRIX) IN SEMI VOLATILE ANALYSIS OF WATER SAMPLES BY DATACHEM

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 10-7-87

Field Sample #'s: 145B,141B,144B,142B

DataChem Sample #'s: EG 2655 - EG 2658

QUALITY ASSURANCE COMMENTS:

2CLFD4 recovery: 86.7% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 73.0% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 98.2% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 86.0% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Mandle DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 10-15-87

Field Sample #'s: 155B,172B,173B

DataChem Sample #'s: EG 2702, EG 2712, EG 2713

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 89.2% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 80.3% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 92.4% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 86.5% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 10-21-87

Field Sample #'s: 184B,200B,212B,220B,223B

DataChem Sample #'s: EG 2819, EG 2823, EG 2827, EG 2839, EG 2830

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 68.2% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 54.9% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 61.2% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 47.6% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 10-24-87

Field Sample #'s: 199B,231B,232B,235B,244B,245B,252B,254B,255B

DataChem Sample #'s: EG 2856 - EG 2862, EG 2864, EG 2865

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 48.1%	Upper Control Limit:	100%
	Lower Control Limit:	52%
13DBD4 recovery: 43.3%	Upper Control Limit:	110%
	Lower Control Limit:	52%
DEPD4 recovery: 50.7%	Upper Control Limit:	132%
	Lower Control Limit:	57%

The recoveries of 2CLPD4, 13DBD4, and DEPD4 are slighly lower than previous data. The data values were tested by QA and are not Dixon outliers. Subsequent analyses demonstrate that recoveries have returned within control limits for this method. The data for this set of samples is statistically acceptable.

DNOPD4 recovery: 47.8%	Upper Control Limit:	135%
	Lower Control Limit:	35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marden DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 10-29-87

Field Sample #'s: 260B,267B,270B,273B,285B,286B,& 278B

DataChem Sample #'s: EG 2929 - EG 2935

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 83.6% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 63.4% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 61.2% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 65.2% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 11-2-87

Field Sample #'s: 259B, 296B, 299B, 307B, 309B, 311B

DataChem Sample #'s: EG 2999 - EG 3002, EG 3004, EG 3006

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 85.0% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 87.5% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 99.4% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 72.2% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marden DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 11-5-87

Field Sample #'s: 318B, 319B, 328B, 329B, 336B, 337B

DataChem Sample #'s: EG 3101 - EG 3106

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 85.0% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 74.1% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 94.0% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 72.5% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 11-11-87

Field Sample #'s: 354B, 356B, 365B, 366B, 367B, 368B

DataChem Sample #'s: EG 3129, EG 3131, EG 3133 - EG 3136

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 88.2% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 80.1% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 108.1% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 52.5% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Maurer DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 11-12-87

Field Sample 376B,377B,385B(Broken in transit),386B,390B

DataChem Sample #'s: EG 3156 - EG 3159

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 100% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 112.3% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is slightly higher than previous recoveries. The value is not a Dixon outlier, and is acceptable.

DEPD4 recovery: 124.6% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 77.0% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 11-18-87

Field Sample 400B,401B,421B,423B,424B

DataChem Sample #'s: EG 3161 - EG 3163, EG 3165, EG 3166

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 108% Upper Control Limit: 100%
Lower Control Limit: 52%

13DBD4 recovery: 118% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery for 2CLPD4 and 13DBD4 were slightly higher than previous recoveries. The values were tested by QA and are not Dixon outliers. They are also acceptable by the square root of 3 test. The data are acceptable.

DEPD4 recovery: 129.5% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 102.5% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 11-19-87

Field Sample #'s: 452B, 453B, 460B, 461B

DataChem Sample #'s: EG 3202 - EG 3205

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 102% Upper Control Limit: 100%
Lower Control Limit: 52%

13DBD4 recovery: 124% Upper Control Limit: 110%
Lower Control Limit: 52%

Recoveries are slightly higher than previous data for 2CLPD4 & 13DBD4. The values were tested by QA and are not Dixon outliers. They are acceptable by the square root of 3 test. The data are acceptable.

DEPD4 recovery: 127% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 72.3% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Maule DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 11-24-87

Field Sample #'s: 465B, 472B, 473B, 490B, 491B, 494B

DataChem Sample #'s: EG 3234 - EG 3238, EG 3241

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 122% Upper Control Limit: 100%
Lower Control Limit: 52%

The recovery of 2CLPD4 is higher than previous data at 122%. The value has been tested by QA and is not a Dixon outlier. The recovery although high is statistically acceptable. Subsequent analyses demonstrate that recoveries have returned within the control limits for this method.

13DBD4 recovery: 106% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 112% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 89.0% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 12-3-87

Field Sample #'s: 501B,502B,511B,512B(broken in transit), 522B 523B,524B,528B

DataChem Sample #'s: EG 3276 - EG 3282

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 65.4%	Upper Control Limit:	100%
	Lower Control Limit:	52%

Recovery is acceptable.

13DBD4 recovery: 55.9%	Upper Control Limit:	110%
	Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery: 83.6%	Upper Control Limit:	132%
	Lower Control Limit:	57%

Recovery is acceptable.

DNOPD4 recovery: 34.8%	Upper Control Limit:	135%
	Lower Control Limit:	35%

Recovery is at the lower control limit and is acceptable. Future analyses will be watched closely for any possible trend toward lower than previous data recoveries.

QUALITY ASSURANCE: Ron Marden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 12-8-87

Field Sample , 535B,536B,544B,545B,559B,560B,556B,555B,558B

DataChem Sample #'s: EG 3292 - EG 3300

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 81.8% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 66.1% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 99.5% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 78.8% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 12-9-87

Field Sample 587B,586B,565B,554B,557B,584B,569B,570B

DataChem Sample #'s: EG 3313 - EG 3320

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 99.0% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 78.9% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 89.0% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 76.5% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE. Ron Marsden DATE: 1/17/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 12-10-87

Field Sample #'s: 602B,603B,612B,613B,616B - 618B

DataChem Sample #'s: EG 3348 - EG 3354

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 96.1% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 100.6% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 125.6% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 69.6% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 12-14-87

Field Sample 627B,628B,637B,638B,646B,647B,651B,652B

DataChem Sample #'s: EG 3368 - EG 3375

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 109% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is slightly higher than previous recoveries. The value was tested by QA and is not a Dixon outlier. It is also acceptable by the square root of 3 test. The data is acceptable.

13DBD4 recovery: 88.9% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 104.5% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 96.1% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Maulea DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 12-21-87

DataChem Sample #'s: EG 3422 - EG 3427, EG 3428 (F), EG 3431, EG 3434 - EG 3440, EG 3443, and EG 3444

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 73.5% — Upper Control Limit: 91%; Lower Control Limit: 57%

Recovery is acceptable.

13DBD4 recovery: 80.6% — Upper Control Limit: 105%; Lower Control Limit: 50%

Recovery is acceptable.

DEPD4 recovery: 99.1% — Upper Control Limit: 129%; Lower Control Limit: 55%

Recovery is acceptable.

DNOPD4 recovery: 71.2% — Upper Control Limit: 132%; Lower Control Limit: 32%

Recovery is acceptable.

QUALITY ASSURANCE: Ru Mandr DATE: 12/24/87

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 12-22-87

DataChem Sample #'s: EG 3514 - EG 3520, EG 3524 - EG 3529,

EG 3530 (F)

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 68.6% — Upper Control Limit: 91%; Lower Control Limit: 57%

Recovery is acceptable.

13DBD4 recovery: 65.6% — Upper Control Limit: 105%; Lower Control Limit: 50%

Recovery is acceptable.

DEPD4 recovery: 86.1% — Upper Control Limit: 129%; Lower Control Limit: 55%

Recovery is acceptable.

DNOPD4 recovery: 49.7% — Upper Control Limit: 132%; Lower Control Limit: 32%

Recovery is acceptable.

QUALITY ASSURANCE: R. Marsh DATE: 12-28-87

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 1-11-88

DataChem Sample #'s: EH 0002 - EH 0004

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 81.1% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 49.3% Upper Control Limit: 110%
Lower Control Limit: 52%

QC recovery of 13DBD4 was slightly lower than previous data at 49%. QA applied a USATHAMA square root of 3 test of acceptability. It was determined that for this analyte, data values with recovery above 30.6 would be acceptable. The date value itself was tested by QA and is not a Dixon outlier. The recovery of 49.3%, although slightly low, is acceptable. QA will monitor future recoveries of this analyte to watch for any trend that might develop.

DEPD4 recovery: 69.7% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 73.0% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marder DATE: 1/12/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 1-12-88

Field Sample #'s: 123D, 130D, 131D, 132D

DataChem Sample #'s: EH 0022 - EH 0025

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 97.7% Upper Control Limit: 100%
Lower Control Limit: 52%

Recovery is acceptable.

13DBD4 recovery: 66.2% Upper Control Limit: 110%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 80.3% Upper Control Limit: 132%
Lower Control Limit: 57%

Recovery is acceptable.

DNOPD4 recovery: 89.6% Upper Control Limit: 135%
Lower Control Limit: 35%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marden DATE: 1/15/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 1-18-88

Field Sample #'s: 159D,160D,167D,168D

DataChem Sample #'s: EH 0056 - EH 0059

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 73.8%	Upper Control Limit:	101%
	Lower Control Limit:	51%

Recovery is acceptable.

13DBD4 recovery: 61.9%	Upper Control Limit:	111%
	Lower Control Limit:	51%

Recovery is acceptable.

DEPD4 recovery: 77.1%	Upper Control Limit:	130%
	Lower Control Limit:	60%

Recovery is acceptable.

DNOPD4 recovery: 84.7%	Upper Control Limit:	127%
	Lower Control Limit:	36%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1-21-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 1-19-88

Field Sample #'s: 179D,180D,192D - 196D

DataChem Sample #'s: EH 0082 - EH 0086

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 101% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 68.1% Upper Control Limit: 111%
Lower Control Limit: 51%

Recovery is acceptable.

DEPD4 recovery: 81.9% Upper Control Limit: 130%
Lower Control Limit: 60%

Recovery is acceptable.

DNOPD4 recovery: 126% Upper Control Limit: 127%
Lower Control Limit: 36%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsh DATE: 1-25-88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 1-26-88

Field Sample #'s: 209D,210D,221D,222D,233D - 236D

DataChem Sample #'s: EH 0126 - EH 0133

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 84.6% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 54.5% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 79.4% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 82.0% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Maunder DATE: 1/28/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 2-1-88

Field Sample #'s: 245D,246D,255D,258D,260D,261D,257D

DataChem Sample #'s: EH 0150 - EH 0156

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 85.1% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 64.9% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 84.2% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 107% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 2/3/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 2-9-88

Field Sample #'s: 273D, 274D, 289D, 290D, 301D, 302D

DataChem Sample #'s: EH 0186 - EH 0191

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 79.9% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 60.9% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 91.0% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 89.8% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 2/12/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 2/23/88

Field Sample #'s: 402D, 403D, 420D, 421D, 432D, 433D

DataChem Sample #'s: EH 0329-EH0334

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 99.6% — Upper Control Limit: 101% / Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 76.6% — Upper Control Limit: 108% / Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 81.4% — Upper Control Limit: 127% / Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 61.7% — Upper Control Limit: 120% / Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 2/26/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 2-26-88

Field Sample #'s: 469D,486D,500D,488D,501D,457D,468D,498D

DataChem Sample #'s: EH 0432 - EH 0439

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 92.5% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 79.4% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 99.2% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 78.2% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Mander DATE: 3/3/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 2-26-88

Field Sample #'s: 442D,443D,454D,455D,456D,458D,459D

DataChem Sample #'s: EH 0340, EH 0341, EH0344 - EH 0346, EH 0348

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery:	101%	Upper Control Limit:	101%
		Lower Control Limit:	51%

Recovery is acceptable.

13DBD4 recovery:	78.2%	Upper Control Limit:	108%
		Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery:	86.4%	Upper Control Limit:	127%
		Lower Control Limit:	61%

Recovery is acceptable.

DNOPD4 recovery:	72.1%	Upper Control Limit:	120%
		Lower Control Limit:	38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 3/3/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-2-88

Field Sample #'s: 499D,510D,511D,522D,523D - 526D(F)

DataChem Sample #'s: EH 0476 - EH 0478,EH 0481 - EH 0485

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 92.0%	Upper Control Limit:	101%
	Lower Control Limit:	51%

Recovery is acceptable.

13DBD4 recovery: 64.1%	Upper Control Limit:	108%
	Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery: 96.2%	Upper Control Limit:	127%
	Lower Control Limit:	61%

Recovery is acceptable.

DNOPD4 recovery: 69.1%	Upper Control Limit:	120%
	Lower Control Limit:	38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsh DATE: 3/4/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ6

Date Analyzed: 3-2-88

Field Sample #'s: 535D,536D,553D,554D,565D.566D

DataChem Sample #'s: EH 0614 - EH 0619

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 85.1% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 55.9% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 113% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 70.0% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 3-4-88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-3-88

Field Sample #'s: 578D,579D,590D,591D,592D

DataChem Sample #'s: EH 0627 - EH 0631

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery:	90.5%	Upper Control Limit:	101%
		Lower Control Limit:	51%

Recovery is acceptable.

13DBD4 recovery:	74.5%	Upper Control Limit:	108%
		Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery:	99.1%	Upper Control Limit:	127%
		Lower Control Limit:	61%

Recovery is acceptable.

DNOPD4 recovery:	83.8%	Upper Control Limit:	120%
		Lower Control Limit:	38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsh DATE: 3/4/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-4-88

Field Sample #'s: 604D,605D,623D,624D,633D,634D,637D,638D

DataChem Sample #'s: EH 0664 - EH 0671

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 77.2%   Upper Control Limit: 101%
                           Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 65.9%   Upper Control Limit: 108%
                           Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 92.9%   Upper Control Limit: 127%
                           Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 76.1%   Upper Control Limit: 120%
                           Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 3-9-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-4-88

Field Sample #'s: 604D,605D,623D,624D,633D,634D,637D,638D

DataChem Sample #'s: EH 0664 - EH 0671

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 77.2%	Upper Control Limit:	101%
	Lower Control Limit:	51%

Recovery is acceptable.

13DBD4 recovery: 65.9%	Upper Control Limit:	108%
	Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery: 92.9%	Upper Control Limit:	127%
	Lower Control Limit:	61%

Recovery is acceptable.

DNOPD4 recovery: 76.1%	Upper Control Limit:	120%
	Lower Control Limit:	38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 3-9-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-15-88

Field Sample #'s: 675D,676D,694D,696D,707D

DataChem Sample #'s: EH 0780 - EH 0784

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 102%	Upper Control Limit:	101%
	Lower Control Limit:	51%

Recovery is 1% above the UCL. 102% is acceptable recovery.

13DBD4 recovery: 87.1%	Upper Control Limit:	108%
	Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery: 93.0%	Upper Control Limit:	127%
	Lower Control Limit:	61%

Recovery is acceptable.

DNOPD4 recovery: 133%	Upper Control Limit:	120%
	Lower Control Limit:	38%

Recovery is higher than previous data at 133%. The value has been tested by QA and is not a statistical outlier. The value is acceptable.

QUALITY ASSURANCE: Ron Marsh DATE: 3-18-88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-17-88

Field Sample #'s: 722D,720D,735D,736D,739D

DataChem Sample #'s: EH 0791 - EH 0795

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 104%	Upper Control Limit:	101%
	Lower Control Limit:	51%

Recovery is slightly higher than previous data at 104%. 104% is reasonable recovery and is acceptable.

13DBD4 recovery: 83.6%	Upper Control Limit:	108%
	Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery: 101%	Upper Control Limit:	127%
	Lower Control Limit:	61%

Recovery is acceptable.

DNOPD4 recovery: 113%	Upper Control Limit:	120%
	Lower Control Limit:	38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 3-22-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-17-88

Field Sample #'s: 645D,646D,656D,657D,658D,659D,666D

DataChem Sample #'s: EH 0717 - EH 0723

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 101% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 78.4% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 94.6% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 111% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 3-22-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-23-88

Field Sample #'s: 748D,750D,768D,770D,784D,785D,787D

DataChem Sample #'s: EH 0826 - EH 0832

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 60.2%   Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 46.9%   Upper Control Limit: 108%
Lower Control Limit: 52%

DEPD4 recovery: 57.2%   Upper Control Limit: 127%
Lower Control Limit: 61%

Recoveries for 13DBD4 and DEPD4 were slightly lower than previous data. Both values were tested by QA and are not Dixon outliers. Both values are acceptable by the square root of 3 test. The data are acceptable.

DNOPD4 recovery: 65%   Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron McMahon DATE: 3-28-88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-23-88

Field Sample #'s: 786D,799D,801D,811D,812D-814D,817D

DataChem Sample #'s: EH 0854 - EH 0861

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 83.6% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 56.2% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 84.8% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 126% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is slightly higher than previous data. The value is not a Dixon outlier, and is acceptable.

QUALITY ASSURANCE: [signature] DATE: 3-30-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-29-88

Field Sample #'s: 831D,833D,851D,852D,866D,867D

DataChem Sample #'s: EH 0868 - EH 0873

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 100%	Upper Control Limit:	101%
	Lower Control Limit:	51%

Recovery is acceptable.

13DBD4 recovery: 85%	Upper Control Limit:	108%
	Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery: 96.4%	Upper Control Limit:	127%
	Lower Control Limit:	61%

Recovery is acceptable.

DNOPD4 recovery: 98.1%	Upper Control Limit:	120%
	Lower Control Limit:	38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 3-31-88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-30-88

Field Sample #'s: 878D,879D,896D,897D

DataChem Sample #'s: EH 0888 - EH 0891

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery:	90.5%	Upper Control Limit:	101%
		Lower Control Limit:	51%

Recovery is acceptable.

13DBD4 recovery:	58.0%	Upper Control Limit:	108%
		Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery:	91.5%	Upper Control Limit:	127%
		Lower Control Limit:	61%

Recovery is acceptable.

DNOPD4 recovery:	87.0%	Upper Control Limit:	120%
		Lower Control Limit:	38%

Recovery is acceptable.

QUALITY ASSURANCE: [signature] DATE: 4/4/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-30-88

Field Sample #'s: 904D (Filtrate)

DataChem Sample #'s: EH 0892 (Filtrate)

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery:	84.4%	Upper Control Limit:	101%
		Lower Control Limit:	51%

Recovery is acceptable.

13DBD4 recovery:	73.1%	Upper Control Limit:	108%
		Lower Control Limit:	52%

Recovery is acceptable.

DEPD4 recovery:	100%	Upper Control Limit:	127%
		Lower Control Limit:	61%

Recovery is acceptable.

DNOPD4 recovery:	86.6%	Upper Control Limit:	120%
		Lower Control Limit:	38%

Recovery is acceptable.

QUALITY ASSURANCE: [signature] DATE: 4/4/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 3-31-88

Field Sample #'s: 914D,915D,930D,931D,962D - 965D

DataChem Sample #'s: EH 0927 - EH 0934

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 98.4% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 49.4% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery for 13DBD4 is 3% below the LCL. The value has been tested by QA and is not an outlier. It is acceptable by the square root of 3 test of acceptability, and is accepted.

DEPD4 recovery: 104% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 121% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is 1% above the UCL. 121% is reasonable recovery for DNOPD4 and is acceptable. The value is not an outlier.

QUALITY ASSURANCE: Ron Marsden DATE: 4/4/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 4-6-88

Field Sample #'s: 979D,980D,997D,998D,999D,1000D

DataChem Sample #'s: EH 0965 - EH 0970

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 91.6% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 53.5% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 92.2% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 77.5% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 4/8/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 4-13-88

Field Sample #'s: 1011D,1012D,1015D,1027D,1028D,1051D,1052D

DataChem Sample #'s: EH 0982 - EH 0988

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 70.8% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 36.5% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is lower than previous data. The value, although low, is acceptable by the square root of 3 test of acceptability. The data are acceptable.

DEPD4 recovery: 75.0% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 58.8% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Musser DATE: 4-18-88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ3

Date Analyzed: 4-14-88

Field Sample #'s: 1065D,1066D,1079D,1080D,1081D

DataChem Sample #'s: EH 1026 - EH 1030

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 65.8% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 52.4% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 78.3% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 96.6% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Mandel DATE: 4-20-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 4-19-88

Field Sample #'s: 1144D,1146D,1156D,1157D,1158D

DataChem Sample #'s: EH 1151 - EH 1155

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 76.9% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 76.4% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 76.2% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 74.5% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

The solid portion of sample EH 1155 (1158D) was lost in extraction, therefore no soil QC results are noted for this set.

QUALITY ASSURANCE: Ron Marsden DATE: 4-21-88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 4-25-88

Field Sample #'s:1171D,1173D,1191D,1193D,1205D,1206D,1217D,1219D

DataChem Sample #'s: EH 1195 - EH 1202

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 68.1% Upper Control Limit: 101%
Lower Control Limit: 51%

Recovery is acceptable.

13DBD4 recovery: 46.4% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is lower than previous data, but falls within the performance standards of 13DBD4. The recovery, although lower than previous data, is acceptable.

DEPD4 recovery: 86.9% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 70.5% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsh DATE: 4-27-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Water # JJ8

Date Analyzed: 4-26-88

Field Sample #'s:1235D,1236D,1237D,1250D,1251D,1239D

DataChem Sample #'s: EH 1217 - EH 1222

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 110% Upper Control Limit: 101%
Lower Control Limit: 51%

Although recovery is slightly higher than previous data, 110% is reasonable, and is acceptable recovery. It is also acceptable by the square root of 3 test of acceptability.

13DBD4 recovery: 80.0% Upper Control Limit: 108%
Lower Control Limit: 52%

Recovery is acceptable.

DEPD4 recovery: 113% Upper Control Limit: 127%
Lower Control Limit: 61%

Recovery is acceptable.

DNOPD4 recovery: 83.7% Upper Control Limit: 120%
Lower Control Limit: 38%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marden DATE: 5-2-88

Arthur D Little

ATTACHMENT E

SURROGATE RECOVERIES (STANDARD MATRIX) IN SEMI VOLATILE ANALYSIS OF SOLID SAMPLES BY DATACHEM

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 10-26-87

Field Sample #'s: 199B, 254B

DataChem Sample #'s: EG 2856, EG 2864

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 93.5% Upper Control Limit: 94%
Lower Control Limit: 61%

Recovery is acceptabl.

13DBD4 recovery: 86.5% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 95.7% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 81.0% Upper Control Limit: 119%
Lower Control Limit: 75%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 11-3-87

Field Sample #'s: 311B

DataChem Sample #'s: EG 3006

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 85.9% Upper Control Limit: 94%
Lower Control Limit: 61%

Recovery is acceptable.

13DBD4 recovery: 77.9% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 89.0% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 84.5% Upper Control Limit: 119%
Lower Control Limit: 75%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 11-11-87

Field Sample #'s: 356B

DataChem Sample #'s: EG 3131

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 78.3% Upper Control Limit: 94%
Lower Control Limit: 61%

Recovery is acceptable.

13DBD4 recovery: 71.6% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 87.7% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 82.3% Upper Control Limit: 119%
Lower Control Limit: 75%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 11-18-87

Field Sample #'s: 423B

DataChem Sample #'s: EG 3165

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery:	97.9%	Upper Control Limit:	94%
		Lower Control Limit:	61%
13DBD4 recovery:	99.5%	Upper Control Limit:	88%
		Lower Control Limit:	59%
DEPD4 recovery:	106.4%	Upper Control Limit:	102%
		Lower Control Limit:	73%

Recoveries for 2CLPD4, 13DBD4, and DEPD4 were slightly higher than previous QC recoveries. No data values are statistical outliers. The recoveries, only slightly higher than previous data, are acceptable.

DNOPD4 recovery:	97.5%	Upper Control Limit:	119%
		Lower Control Limit:	75%

Recovery is acceptable.

QUALITY ASSURANCE: Ron V Marsden DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 11-24-87

Field Sample #'s: 494B

DataChem Sample #'s: EG 3241

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 71.8%   Upper Control Limit: 94%
Lower Control Limit: 61%

Recovery is acceptable.

13DBD4 recovery: 78.6%   Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 100.5%   Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 93.2%   Upper Control Limit: 119%
Lower Control Limit: 75%

Recovery is acceptable.

QUALITY ASSURANCE: Ron ?? Jarden DATE: 1/19/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 12-8-87

Field Sample #'s: S56B

DataChem Sample #'s: EG 3298

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery:	69.1%	Upper Control Limit:	94%
		Lower Control Limit:	61%

Recovery is acceptable.

13DBD4 recovery:	59.4%	Upper Control Limit:	88%
		Lower Control Limit:	59%

Recovery is acceptable.

DEPD4 recovery:	89.5%	Upper Control Limit:	102%
		Lower Control Limit:	73%

Recovery is acceptable.

DNOPD4 recovery:	107.5%	Upper Control Limit:	119%
		Lower Control Limit:	75%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 12-10-87

Field Sample #'s: 616B

DataChem Sample #'s: EG 3354

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery:	54.1%	Upper Control Limit:	94%
		Lower Control Limit:	61%
13DBD4 recovery:	47.4%	Upper Control Limit:	88%
		Lower Control Limit:	59%
DEPD4 recovery:	67.5%	Upper Control Limit:	102%
		Lower Control Limit:	73%

Recoveries for 2CLPD4, 13DBD4, and DEPD4 were slightly lower than previous QC recoveries. No data values are statistical outliers by Dixon. The recoveries, only slightly lower than previous data, are acceptable.

DNOPD4 recovery:	100%	Upper Control Limit:	119%
		Lower Control Limit:	75%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marden DATE: 1/19/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 12-21-87

DataChem Sample #'s: EG 3428 (Solid)

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 65.4% Upper Control Limit: 94%
Lower Control Limit: 61%

Recovery is acceptable.

13DBD4 recovery: 62.6% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 82.9% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 116% Upper Control Limit: 119%
Lower Control Limit: 75%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marden DATE: 12/24/87

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method Semi-Volatiles / Soil # L9

Date Analyzed: 12-22-87

DataChem Sample #'s: EG 3530 (Solid)

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery 65.3% Upper Control Limit: 94%
Lower Control Limit: 61%

Recovery is acceptable.

13DBD4 recovery 62.8% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 90.0% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 101% Upper Control Limit: 119%
Lower Control Limit: 75%

Recovery is acceptable.

QUALITY ASSURANCE: DATE: 12-28-87

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 1-19-88

Field Sample #'s: 194D

DataChem Sample #'s: EH 0086-S

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 83.7% Upper Control Limit: 94%
Lower Control Limit: 61%

Recovery is acceptable.

13DBD4 recovery: 83.8% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 81.5% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 120% Upper Control Limit: 119%
Lower Control Limit: 75%

Recovery is 1% above the upper control limit. The value has been tested by QA and is not a Dixon outlier. The data is acceptable. Future analyses of this analyte will be monitored closely by QA to watch for a trend.

QUALITY ASSURANCE: Ron Marsden DATE: 1-25-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 2-1-88

Field Sample #'s: 257D

DataChem Sample #'s: EH 0156-S

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 67.8% Upper Control Limit: 94%
Lower Control Limit: 61%

Recovery is acceptable.

13DBD4 recovery: 63.2% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 75.3% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 124% Upper Control Limit: 119%
Lower Control Limit: 75%

Recovery is 5% above the upper control limit. The value has been tested by QA and is not a Dixon outlier. The data are acceptable.

QUALITY ASSURANCE: Ron Marsh DATE: 2/3/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 2-26-88

Field Sample #'s: 458D

DataChem Sample #'s: EH 0347-S

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 97.8% Upper Control Limit: 94%
Lower Control Limit: 61%

Recovery is slightly higher than previous data. The value is not a Dixon outlier. 97.8% is reasonable recovery. The data are acceptable.

13DBD4 recovery: 82.9% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 103% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is 1% above the UCL of 102%. The value is not an outlier. 103% is reasonable recovery. The data are acceptable.

DNOPD4 recovery: 119% Upper Control Limit: 119%
Lower Control Limit: 75%

Recovery is acceptable.

QUALITY ASSURANCE: [signature] DATE: 3/3/88

Arthur D Little

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 3-17-88

Field Sample #'s: 739D (S)

DataChem Sample #'s: EH 0795-S

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 73.0% Upper Control Limit: 98%
Lower Control Limit: 68%

Recovery is acceptable.

13DBD4 recovery: 64.8% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 91.3% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 102% Upper Control Limit: 123%
Lower Control Limit: 72%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 3-22-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 3-23-88

Field Sample #'s: 817D (S)

DataChem Sample #'s: EH 0861-S

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 82.2% Upper Control Limit: 98%
Lower Control Limit: 68%

Recovery is acceptable.

13DBD4 recovery: 77.0% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 93.2% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 101% Upper Control Limit: 123%
Lower Control Limit: 72%

Recovery is acceptable.

QUALITY ASSURANCE: Don Marsh DATE: 3-30-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 4-13-88

Field Sample #'s: 1015D (S)

DataChem Sample #'s: EH 0984-S

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 54.6% Upper Control Limit: 98%
Lower Control Limit: 68%

13DBD4 recovery: 52.7% Upper Control Limit: 88%
Lower Control Limit: 59%

Recoveries of 2CLPD4 and 13DBD4 are slighly lower than previous data. The recoveries, although lower than previous data, are within the performance standards of the method. The data are acceptable.

DEPD4 recovery: 80.6% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 108 % Upper Control Limit: 123%
Lower Control Limit: 72%

Recovery is acceptable.

QUALITY ASSURANCE: R. Mauk DATE: 4-18-88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 4-1-88

Field Sample #'s: 904D (S)

DataChem Sample #'s: EH 0892-S

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 72.9% Upper Control Limit: 98%
Lower Control Limit: 68%

Recovery is acceptable.

13DBD4 recovery: 68.9% Upper Control Limit: 88%
Lower Control Limit: 59%

Recovery is acceptable.

DEPD4 recovery: 91.8% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 87.0% Upper Control Limit: 123%
Lower Control Limit: 72%

Recovery is acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 4/4/88

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Semi-Volatiles / Soil # L9

Date Analyzed: 4-26-88

Field Sample #'s: 1239D (S)

DataChem Sample #'s: EH 1222-S

QUALITY ASSURANCE COMMENTS:

2CLPD4 recovery: 93.4% Upper Control Limit: 98%
Lower Control Limit: 68%

Recovery is acceptable.

13DBD4 recovery: 90.4% Upper Control Limit: 88%
Lower Control Limit: 59%

Although recovery is slightly higher than previous data, 90% recovery is acceptable.

DEPD4 recovery: 99.9% Upper Control Limit: 102%
Lower Control Limit: 73%

Recovery is acceptable.

DNOPD4 recovery: 103% Upper Control Limit: 123%
Lower Control Limit: 72%

Recovery is acceptable.

QUALITY ASSURANCE: [signature] DATE: 5-2-88

ATTACHMENT F

EXAMPLE OF DATA OBTAINED FOR SURROGATE RECOVERIES
FROM NATURAL MATRICES IN SEMI VOLATILE ANALYSIS BY DATACHEM

SURROGATE PERCENT RECOVERY SUMMARY

DataChem Set ID S88-0077

Sample No.	2CLPD4	13DBD4	DEPD4	DNOPD4
QCMB- H2O	101.	78.2	86.4	72.1
QCMB- SOIL	97.8	82.9	103.	119.
EH0340	86.8	70.9	64.6	79.2
EH0341	94.7	80.3	82.8	67.0
EH0344	60.6	46.8	44.5	48.1
EH0345	80.3	66.1	79.2	79.9
EH0346	95.4	72.7	83.9	94.2
EH0347- F *	94.2	68.2	73.9	80.3
EH0347- S *	93.0	80.6	106.	140.
EH0348	63.8	50.7	45.5	36.3

Abbreviations

2CLPD4	2-chlorophenol-D4
13DBD4	1,3-dichorobenzene-D4
DEPD4	diethylphthalate-D4
DNOPD4	di-n-octylphthalate-D4

QCMB is the abbreviation for the QC method blank.

* F - Filtrate portion

* S - Solid portion

METHODOLOGY

The method employed in this analysis is based upon standard EPA methods for which DataChem has been certified by the United States Army Toxic and Hazardous Materials Agency (USATHAMA). Following method JJ8 for water samples, a measured volume of water, 800 milliliters, is serially extracted with methylene chloride using a separatory funnel. The methylene chloride extract is dried, concentrated to a volume of 1 mL, and analyzed by GC/MS. Qualitative identification of the parameters in the extract is performed using the retention time and the relative abundance of characteristic masses (m/z) (aminimum of three masses). Quantitative analysis is performed using the internal standard technique with a single characterisitic mass (m/z).

The internal standard procedure requires addition of an internal standard(D10 phenanthrene) to each sample just prior to analysis, spiked at 50 ug/mL by the addition of 10uL of a stock solution. The internal standard is an isotope-labeled analogue of an EPA priority pollutant. Isotope-labeled internal standards have the obvious advantage in MS analysis of behaving much the same chromatographically as their neutral analog yet having a different mass spectra. Even when coelution occurs they can easily be distinguished from their undeuterated counterparts and thus do not interfere with the qualitative analysis.

METHODOLOGY

The method employed in this analysis for the solid portion of sample EH0347 which was a watery sludge is based upon standard EPA methods for which DataChem has been certified by the United States Army Toxic and Hazardous Materials Agency (USATHAMA). Sample preparation was performed following Method L9 involving soxhlet extration of each solid sample. The methylene chloride extract is dried, concentrated to a volume of 1 mL, and analyzed by GC/MS. Qualitative identification of the parameters in the extract is performed using the retention time and the relative abundance of characteristic masses (m/z) (a minimum of three masses). Quantitative analysis is performed using the internal standard technique with a single characteristic mass (m/z).

The internal standard procedure requires addition of an internal standard (D10 Phenanthrene) to each sample just prior to analysis, spiked at 50 ug/mL by the addition of 10 uL of a stock solution. The internal standard is an isotope-labeled (deuterated) analogue of an EPA priority pollutant. Isotope-labeled internal standards have the obvious advantage in MS analysis of behaving much the same chromatographically as their neutral analog yet having a different mass spectra. Even when coelution occurs they can easily be distinguished from their undeuterated counterparts and thus do not interrere with the qualitative analysis.

ATTACHMENT G

EXAMPLE OF QUALITY CONTROL DATA (STANDARD MATRIX SPIKES)
FOR NITRATE PLUS NITRITE (N) ANALYSIS BY DATACHEM

DATACHEM

QUALITY ASSURANCE REVIEW

A.D. LITTLE

****

USATHAMA Method: Nitrate / Water # LL8

Date Analyzed: 10/15/87

Field Sample #'s: 163B - 171B, 174B, 175B

DataChem Sample #'s: EG2703 - EG2711, EG2714 - EG2715

QUALITY ASSURANCE COMMENTS:

Nitrate recovery:

Low Spike: 105%	Upper Control Limit:	114%
	Lower Control Limit:	88%
High Spike Mean: 101%	Upper Control Limit:	112%
	Lower Control Limit:	87%

Recoveries for both low and high spike QC's are acceptable.

QUALITY ASSURANCE: Ron Marsden DATE: 1/19/88

Arthur D Little

ATTACHMENT H

DATACHEM LETTER REGARDING CONTROL CHARTS

DataChem

August 24, 1988
Refer to: 88PM332

Arthur D. Little, Inc.
20 Acorn Park
Cambridge, MA 02140

Atten: Itamar Bodek, Ph.D.

Dear Dr. Bodek

This letter is being writing as per your request in our telephone conversation on Thursday, August 25, 1988.

DataChem is providing A.D. Little with USATHAMA control charts for the same Analytes and time period that the A.D. Little samples were analyzed in. These control charts do not contain A.D. Little data however DataChem did evaluate each A.D. Little data point by the same criteria as USATHAMA data points to ensure that they were in control. This was done one point at a time so that it would not affect the USATHAMA data base by using non-USATHAMA data.

DataChem has also provided A.D. Little with a QC statement that explains the evaluation of each point made by Quality Assurance. This statement is signed and dated by the DataChem QA Manager.

DataChem would like to apologize for any inconvenience that has been experienced by A.D. Little and would look forward to serving you in the future.

Sincerely,

A. Brent Torgensen
Project Manager

960 West LeVoy Drive
Salt Lake City, Utah 84123
801 266-7700
FAX 801 268-9992

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